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AND

NOTICES OF ALL PATENTS GRANTED FOR INVENTIONS.

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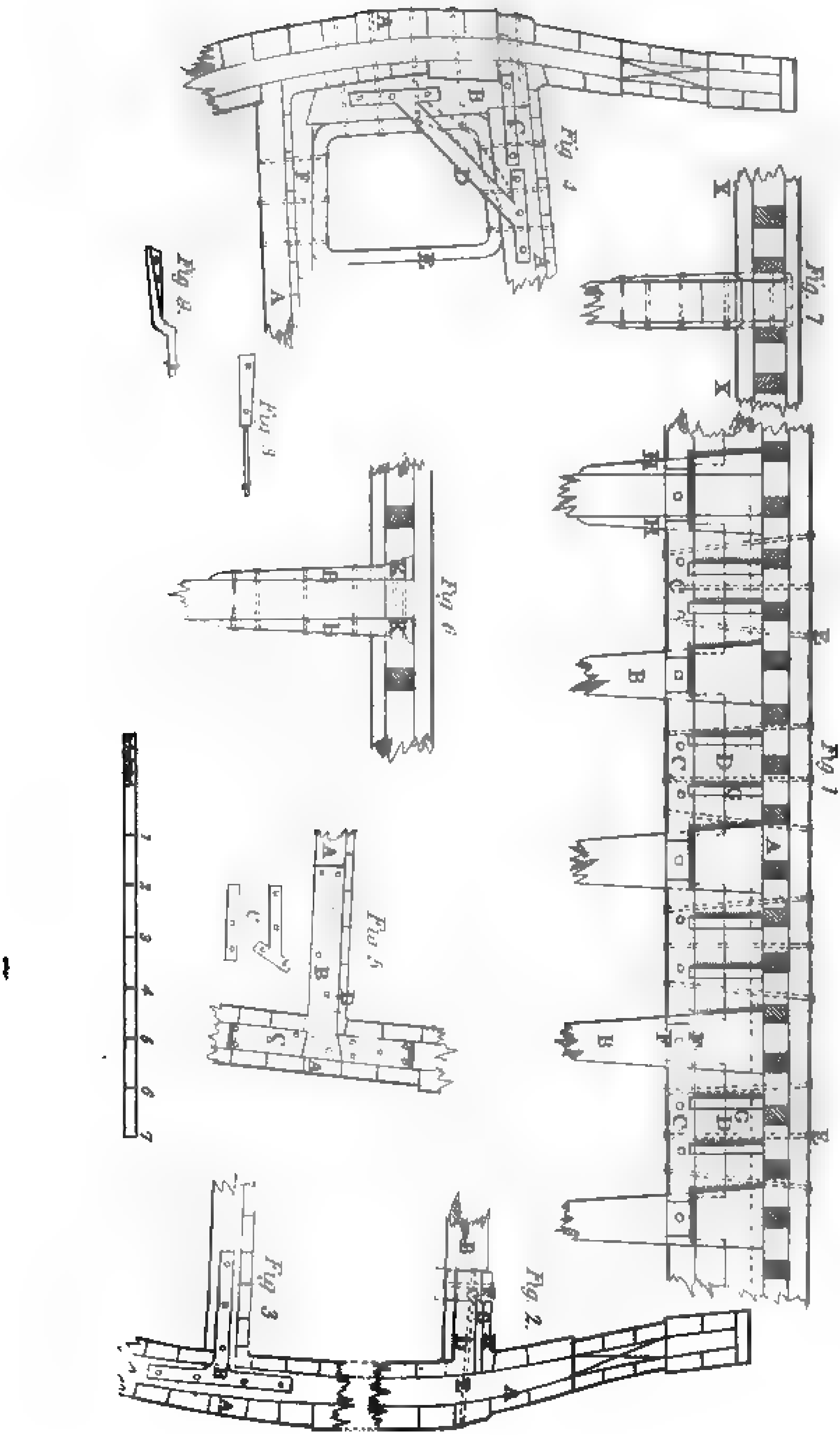
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THE
REPERTORY
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ARTS, MANUFACTURES,
AND
AGRICULTURE.

NUMBER XIII. SECOND SERIES. JUNE 1, 1803.

Specification of the Patent granted to JOSEPH BRINDLEY, *of Rochester, in the County of Kent, Ship-builder; for certain Methods of more effectually securing Ships Beams to their Sides.* Dated September 20, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Joseph Brindley do hereby declare that my invention is described in the drawings and descriptions thereof. (See Plate I.) In witness whereof, &c.

REFERENCES to Plate I.

Fig. 1, is a representation of part of the flat of a ship's deck. A, are the timbers and plank of a ship's side, as commonly constructed. B, B, are the beams, with an increased scantling at the ends, for the purpose of strength, and to admit a deeper tenon and mortise for the tie-pieces C; but if, in converting the beams, it may

 not

of receiving the fastenings of another strake next the strake F. G, the ledges to receive the fastenings of the deck; and H, the waterways and plank on the deck, as in the common way. I, represents an additional increase of strength, and to be used or omitted occasionally, being a scantling piece or pieces of timber, let upwards, tenoned or mortised to the beams, and to be in contact with the tie-pieces C, and fastened to the tie-pieces C, planks F, and beams B, with bolts, cokes, nails, or tree-nails, and to have scantling pieces filled in between it or them and side of the ship, and bolted through all in the same manner as the fillings D, if necessary, or omitted, as circumstances may require.

Fig. 3, represents another method of strength. A, is part of the plank and timber of the side and beam of the ship as usual. B, is an iron T plate or plates, and occasionally knees, on one or on each side the beams and timbers of the ship's frame, let in (or not let into) the sides of the timbers, and properly fastened to the beams and timbers with bolts, cokes, or nails.

Fig. 4, represents another method of strength. A A A, is the side of the ship, with beams, &c. B, scantling pieces of timber fayed to the ship's side, and mortised to the end of the beam, and properly secured to the ship's side with bolts; but in some cases B may run up sufficiently to receive the end of the beams, which may be cut off and butted against it. the end of B must be cut, and the wood taken away, for the beam to lodge upon it, or cleated under the beam. C, is an iron strap, to go round the scantling piece B, and bolted to that and the sides of the beams; the strap may occasionally go round the timbers of the ship's frame and bolt to them and beams, &c. as circumstances may require. D, is an iron brace or braces, properly secured in, and bolted to, the beam and

and scantling piece B; the brace D may vary in shape according to the dotted lines, or be occasionally made into the form of a quadrant of a circle. E, is an iron square, bolted through the beams of the deck, sole F, and scantling piece B, and side of the ship: the square may be in contact with, and bolted through, the ship's side next the plank withinside, and occasionally used in the midship of ships.

Fig. 5, is another method of strength. A A, represent the beam, timber, and planks of the ship's side, &c. B, is a scantling or check piece or pieces of timber, to be bolted and coked, or tree-nailed, on one or on each side of the timbers of the frame and the sides of the beams to run through the openings of the ship's frame to nearly the outside of the timbers, and to form a dovetail against the side of the timber of the frame. C, C, are pieces of timber, fastened on each side of the timbers of the frame (and planks of the ships side occasionally) with keys, cokes, bolts, nails, or tree-nails, and their ends to butt on the scantling piece B in the form of dove-tails. D, is a coke of iron or wood, let into the scantling piece B and the waterway; in some cases the waterway may let into a score on the checks B. C, C, are plates of iron, brought and fastened against the check pieces B, and to be used or omitted occasionally.

Fig. 6, is a representation of the check pieces B with the dove-tails K, K, to be used or omitted, as circumstances may require, and fastened to the beams and ship's side with cokes, bolts, nails, or treenails, and in conformity to Fig. 5, the dove-tails K, K, may be formed by the sides of the timbers being in contact with the check pieces B, or an opening may be left for pieces of iron or wood to be joined in between.

Fig.

Fig. 7, represents the iron strap C in Fig. 4 round the scantling piece B, or round the outside of the timbers of the frame, with the fastenings to the beam, &c. and in conformity to Fig. 4.

Fig. 8, is another method of strength, and may be used occasionally, being a tie-bolt or bolts placed on one side, or on all sides of the beams, drove through the side of the ship, and clenched, forelocked, or screwed with nuts without board, and fastened withinside to the beams with cokes, nails, or bolts, and occasionally let into the beams, or otherwise, as circumstances may require.

Fig. 9, is a neck bolt or bolts, to be used occasionally, drove through the tie-pieces C, and well clenched, screwed, or forelocked, and fastened properly to the side of the beams, for the purpose of assisting the strength of the mortise or tenon in the sides of the beams, or wooden braces may be used for the same purpose, fastened to the underside or upperside of carlings, and to the tie-pieces C, on a thwart-ship direction. The braces may be dove-tailed, keyed, or coked to the tie-pieces C, planks F, and carlings of the ship. The tie-pieces C, in Fig. 1, may (instead of mortising to the pieces H, H,) mortise and tenon to each beam, and cleats butted against the tie-pieces C, properly coked and fastened to the beams, if (as in some cases) the beams of ships run through to the outside of the timber of the frame. Then they may be secured to the ship's side in a similar manner as the check pieces B, in Figs. 5 and 6, with pieces dove-tailed on their ends, &c. In some cases part of the method in Fig. 1 may be omitted by the exclusion of the whole or part of the scantling pieces D; but I by all means prefer the use of all the scantling pieces D in conjunction with the tie-pieces C, bolts E, and side of the ship.

The

The drawings to which my specification refers, are by a scale of three-quarters of an inch to one foot * ; but as the methods are applicable to different descriptions of ships or vessels, it is necessary to observe, that the materials used may be increased or decreased in number and size, in proportion as circumstances may require. The strength of every part of them must be proportioned to the security required, which to a workman can be no difficulty to ascertain, and properly provide for. And as these methods of connexion are very extensive in their applications, it is proper to observe, that some of them may be used separately, and some of them conjunctively, according to the different ships or vessels on which they are used.

Observations by the Patentee.

This invention having for its object an important improvement in the practical part of ship-building, it cannot but be highly interesting to the country, and particularly to mariners, merchants, and ship-builders: for all who have observed the powerful lever created by the masts and sails operating against the body of the vessel, and have experienced the violent and convulsive motion of a ship in gales of wind, must allow that the proper fastening of the ship's sides to the beams is of the utmost consequence ; for I verily believe that hundreds of ships, and thousands of brave men, have perished through defects in that part of ship-building. The mode most commonly used at present to secure the beams to the sides of ships, is to have one hanging and one lodging knee to each beam. But in the greatest number of ships built in the North of England, the hanging-knees, for the sake of

* In the plate they are reduced one-half.

stowage,

stowage, are omitted, and the only fastening they have are the lodging-knees. My plan is to exclude the use of lodging-knees altogether; but it may be used in conjunction with hanging-knees, if thought necessary. It is my intention to demonstrate, under three distinct heads, a few of the many national advantages that will result from my method of connexion. First, superior strength; secondly, the saving of expense; and, thirdly, the great benefit of expedition. In respect to strength, I will just observe, that there is an established axiom in mechanics, that in the fabrication of any mechanical body, as a ship, it is perfect and complete when all the component parts have an equal share of strength in proportion to the resistance required. I will prove (by the following comparison) that the methods as described in Fig. 1, come nearer to such a state of perfection than any other mode now practised. Suppose (for instance, as is now the practice) five beams are fastened to the side by five lodging-knees, bolted in and out, and fore and aft ways, it is certain the five knees are attached to each beam separately; for by being cut off, and let down between the beams or upper edge of the clamps, it is evident that each knee can only affect the one beam to which it is fastened; it can have no connexion, nor lend any assistance to another; so that when a beam happens (which is very common) to be a little short of timbers at the ship's side, the motion and working of the ship soon gulls the holes, loosens or breaks the bolts, and renders the lodging-knee useless. Hence the dependance of the beam is reduced to the hanging-knee alone, which is more particularly designed for another purpose; *viz.* to resist the lateral twist of the ship occasioned by the straining of the masts and sails, and the weight of metal, &c. &c. And I am convinced the principal cause of the

failure

failure in the hanging-knees, is their being forced to answer two purposes, and not being equal to the resistance required. Innumerable are the disadvantages and dangers attending the use of lodging-knees; especially in such ships (as before observed) where nothing but lodging-knees are used. All these dangers and inconveniences will be avoided by the adoption of the plan I propose. For by the tie-pieces or carlings C, mortised into the five beams, and bolted through the fillings D, and side of the ship; then the thick plank F bolted up and downways to the beams and tie pieces C, the five beams are united together, and make one compound of strength, which may be continued all fore and aft; and every beam of the deck will have such an immediate connexion with the ship's side, and with each other, as to make it impossible there can be any partial strain, or working in one beam more than another. The whole are connected upon the same principle of strength as the shifts of plank on a ship's bottom. It is necessary to observe that the strake or plank F, is one, two, (or more inches) thicker than the other planks of the deck; and is let into a score or mortise (preserving its entire thickness and breadth) on the top of the beams; so that the beams cannot work separately athwart ships without breaking the plank F edgewise; which is impossible, as the other planks of the deck are caulked and nailed to the beams and ledges on each side of it, and jambed in such a manner as no one part can give way without the whole; the tie-pieces cannot work sidewise, because they are bolted to the plank F, and all the ledges are butted in a mortise against them, entirely across the ship; and all the planks of the deck nailed to the beams and ledges; making, together, such an immense power of connection that no possible complaint can exist against the

practice of this simple plan of improvement. But another very important advantage in point of strength (attending these methods), is, that it not only unites the ship's sides to the beams more securely than was ever before practised, but it strengthens and stiffens the sides of the ship, all fore and aft, in a very remarkable manner: for it ought to be noticed, that one side of the ship is equally binding as, and most materially assists the other. To prove this, I will suppose a ship (secured upon this plan) was to receive a blow from another, at the height of the range of the deck, by the concussion the beams would have a tendency to recede from that side of the ship next whence the blow was received, and break the bolts and tear away the mortises at the side and on the top of the beams: but this could not take place unless the mortises on the top of the beams were to tear away on the opposite side of the ship at the same time; which, in my opinion, is next to an impossibility, for this evident reason, if the mortises on the top of the beams tear away by the concussion on that side, it must be in an opposite direction to the ship's side, *viz.* entirely across the deck, which is too improbable a case: and I am persuaded it must be evident to every one, who is not prejudiced by long habit and custom, that the plan I recommend is one universal, solid, and compact body of mechanism, simple in its operation, and perfect when executed.

In respect to the saving, I will just state that it is unnecessary to enter into a particular detail of every expenditure that will accompany this plan, for it will vary according to circumstances, in proportion to different ships and vessels on which it may be practised, and also the places where it may be used. I do assert, that it will

save

save (at least) two-thirds of the value of all the lodging-knees used in a first-rate ship of war, and as much in an East Indiaman and all other ships in proportion. On board the Victory, of 100 guns, there are about 360 lodging-knees, and at the present high price the Navy-Board allows for knee-timber, let any one calculate, and they will find, by the use of my plan, the saving to be almost incredible. There is still another very important fact, and what is of the utmost national consequence. It will save immense quantities of fine oak-timbers, which are now destroyed to obtain knees for the navy, &c. The trunks of thousands of trees are cut asunder to obtain the limbs for knees, which trunks would otherwise make some of the best futtecks in ships frames. I do not mention this from imperfect information; it is a fact I have been witness to, and know it is a practice very common. I have no doubt but many of the gun-deck-knees of a first-rate ship of war were cut from timber logs that measured from fifty to one hundred feet or more in each log; and the reason of this will appear obvious to every one who considers the disproportionate size of the body to the limbs. The East India Company have (from the great difficulty of obtaining wood knees) substituted iron ones in their ships, which is very expensive, and inadequate to the purpose, for it is impossible the fastenings in iron knees can be so safe as where wood and iron are united together, for the following plain reason: the bolts that go through iron knees are only prevented from drawing out by the head and clench of the bolt, whereas in all fastenings of wood the bolts are driven with a strong drift to them, which, added to their head and clench, must make them infinitely stronger than the fastenings in iron knees, which ought never to be used but in cases of real necessity. I will observe on this head, that, inde-

pendant of the great strength obtained by my methods of connexion, in point of expense every public body, as well as private individual, will find their own interest in the use of them.

This plan admits of many advantages in respect to expedition; but I will confine myself to one or two of them. In the present practice, where hanging and lodging knees are used, the fore and aft bolts are conveyed through the beam and each knee, and they must all be complete before the waterways and planks of the deck can be laid; but such is the extreme difficulty to obtain knees, that ships are kept from launching, and in docks, many months longer than otherwise they would be, besides exposing the insides of ships to heavy rains, which rot the timbers and ends of the beams. This is a very serious and important consideration. The plan I propose will remove these inconveniences, as, not having any connexion with hanging-knees (which, for the better carrying my plan into effect, may be fastened to the under side of the beam) it can be used immediately. The beams are crossed and lodged on the clamps, and the waterways and planks of the deck laid and caulked, and the rains prevented from rotting the ends of the beams, and the inside of the ship's timbers, &c. &c.; and it is so simple that it may be executed by the meanest workman that can be called a shipwright. Another very important advantage is, that, in old ships that want repairs, many of the beams are found to be rotten at their ends, parts that always begin to decay first, for the reasons before observed, consequently the fore and aft bolts through the beams can have no security in the rotten part of the beam; so that while the present practice continues of using lodging-knees, it becomes necessary to take out the beams, and replace them with new ones, in which a great deal

deal of time is taken up, and immense expense incurred. This may be completely obviated by having long cheek pieces of timber bolted and fastened to the sides of such beams that are only decayed at the ends; then the tie-pieces C can be morticed by them, and bolted through the ship's side, as before described in Fig. 1. This will not only facilitate the repairs of old ships, but it will at the same time save a prodigious expense. Many other advantages will accompany my methods of connexion, which will be obvious to every one conversant with ship-building.

Specification of the Patent granted to BENJAMIN HADEN, *of the Parish of Sedgley, in the County of Stafford, Bagging-weaver; for an Improvement in the Manufacture of Bagging for packing of Nails, and other Purposes.* Dated February 28, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Benjamin Haden do hereby declare, that my said invention of an improvement in the manufacture of bagging for packing of nails, and other purposes, is described in manner following; that is to say: I take for my warp, hurds, or tow, prepared in the usual way, such as are at present used in making nail-bagging, but for my weft or woofs I take old ropes, or junk, of any dimensions; and after untwisting or dividing the threads or filaments thereof, I wind the same into bobbins or quills, and they then become fit for the shuttle, and I weave them along with the common warp in the common

mon way. I do not confine my invention to bagging for nails, but the same may be used with advantage for bagging for coals, cokes, and for various other purposes, where strength and durability are required, needless to be mentioned here. In witness whereof, &c.

Observations by the Patentee.

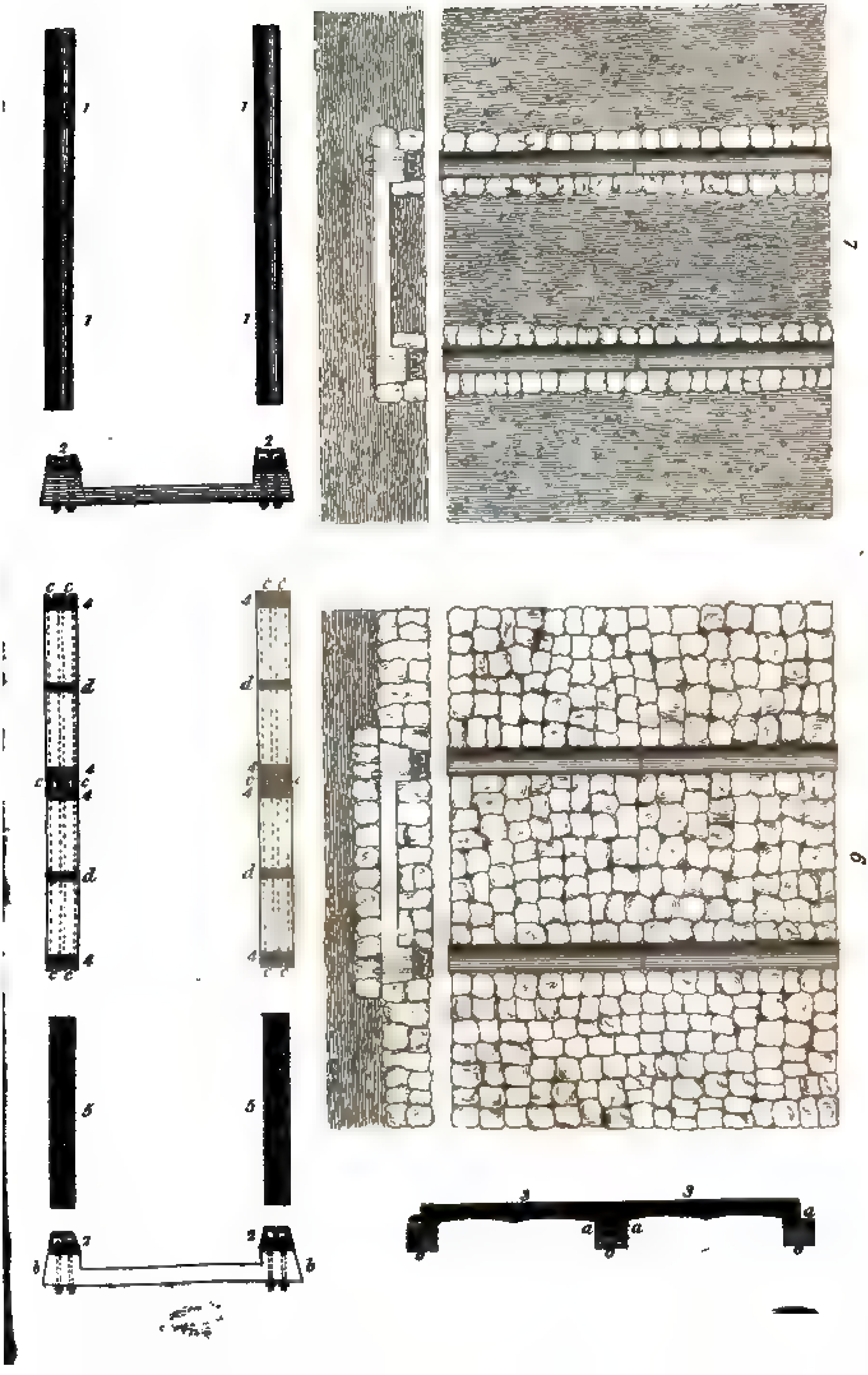
I wish it to be known to those persons who are in the habit of using bagging for which my invention is calculated, that the materials I have described in my specification are peculiarly adapted to give strength and durability to that article. The yarn of which ropes are generally made, particularly king's ropes, is spun from the choicest hemp, and strongly impregnated with tar. The threads taken from the middle of such ropes, not having been exposed either to the weather or to friction, are as sound and as strong as when originally used; and, if not quite equal to new, can be but little inferior. The tarry matter with which these threads are impregnated, renders them peculiarly advantageous in the manufacturing of coal-sacks; the weft being composed of these threads, fine spun, good and strong, adhere firmly to the warp made from hemp in the original way. Sacks made of this cloth are strong, tenacious, and not liable to rent or perish by wet, to which those in present use are particularly subject. The superiority of this invention for nail-bagging is very conspicuous: the weft of those now used is made from the coarsest refuse of flax or hemp that can be procured. The consequence of which is, that the bags frequently perish and burst in carriage, to the great loss of those concerned.

Specification of the Patent granted to JONATHAN WOODHOUSE, *of Ashby-de-la-Zouch, in the County of Leicester, Civil Engineer; for a new Method of forming a Cast-Iron Rail, or Plate, which may be used in making Iron Rail Roads, or Trays, for the working and running of Waggons, Drays, and other Carriages, on public and other Roads; and also, a new Method of fixing, fastening, and securing such Cast-Iron Rail, or Plate, on such Roads.* Dated February 28, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that the said Jonathan Woodhouse, in and by this his instrument in writing, under his hand and seal, pursuant to, and in compliance with, the terms of the said in part recited proviso, doth hereby declare, that the said invention is described in manner following; that is to say: The rail or plate is made of cast-iron, and the upper part or surface thereof is concave: the width of which rail or plate may be increased or diminished as may best suit the size of the wheels of the carriages that may be worked upon the particular roads where the rails or plates are used. The method of fixing, fastening, and securing the cast-iron rails or plates is to place them on bearings, at convenient distances, which are to be fixed firm and solid in the earth, and to fasten the rails or plates to such bearings with wrought-iron screws, or cutter bolts. The bearings for the rails or plates may be made of timber, stone, cast-iron, or wood-piles; and if the rails or plates are properly fixed to such bearings with wrought-iron screws, or cutter bolts, and the road is made even with the surface of the external or outer edges of the rails or plates either with stone

stone, gravel, or wood, or any other road materials, the rails or plates will be immoveable, and the wheels of the carriages used thereon will pass over the same with facility; and, by reason of the concave form and manner of fixing of the said rails or plates, no shock which they can receive (except some wilful force is maliciously used) can injure or break them. Those rails or plates may be used on private as well as on public or other roads, with a great advantage where a multiplicity of business is to be carried on; and by reason of such the concave form, and manner of fixing them, they admit of the wheels of carriages to get upon, or from them, with facility in any direction. And the wheels working on those rails will move with great smoothness and ease. The above or annexed plans or drawings shew the cast-iron rails or plates (see Plate II.); and the method of fixing, fastening, and securing them, of which the following are the explanations. The plans or drawings, numbered 1, shew the upper surface of the rails or plates upon which the different carriage wheels are intended to run. The drawings numbered 2, shew the elevation or end view of the plates or rails, and likewise the concavity of their upper surface, and their form at the ends and sides, and how they are fixed to the bearings. The drawings numbered 3, shew the side view of the rails with the bearings under them. The parts in which drawings marked *a, a, a, a,* shew the ends of the feet, or the bases of the metal which rest on the bearings. And the letters *b, b, b, b, b,* on the drawings numbered 2 and 3, shew the bearings upon which the aforesaid bases or feet rest. The drawings or sections, numbered 4, shew the section of the base or underside of the rails or plates; distinguishing the recesses in the feet of the rails as at *c c, c c, c c, c c, c c, c c.* These recesses are purposely made to receive the wrought-



wrought-iron screws or cutter bolts, which serve the double purpose of preserving and securing the cast-iron rails or plates in a direct line with each other, and of firmly securing them on their respective bearings. *d, d, d, d,* in the same drawings or sections, shew the stays cast between the sides of the rails or plates, which brace them together at the bottom edges. The drawings or sections of the plate numbered 5, shew the upper surface of a diced or chequered rail or plate, which will be convenient and proper to be laid in sheets, and where roads meet or cross each other, as they will prevent the horses feet from slipping, and will therefore be more particularly useful in such roads or shoots as have a declivity or descent. The two drawings numbered 6, shew the surface of the iron-rails or plates when fixed in a road or street, where the road or street is paved with stone. The two drawings numbered 7, shew the iron-rails in a public or common road, made with the usual materials of gravel and stone, or other road materials, with this difference, that with a view to keep the rail or plate as free from gravel, sand, and other things as possible, a course of stones is placed on each side of the rail or plate, but which may be used or not, as is found most convenient. And the said Jonathan Woodhouse doth hereby declare and affirm that the particulars, above set forth, do contain a full, true, and perfect description of the nature of the said invention. In witness whereof, &c.

Remarks on the Advantages of Concave Iron Roads, By the Patentee.

Two horses would on this road convey a mail coach more than eight miles *per* hour as easy as the present mails are conveyed six miles *per* hour by four horses.

 The

The conveyance would be so easy that gentlemen might read nearly as well as on board a ship: The even and compact manner in which this road would be laid, would render it the safest of all others, with the additional advantage of using wheels of any diameter. As this road might be kept constantly moist it would have a singular advantage over other iron roads, in keeping the metal perfectly cool, and consequently less friction and wear. It has ever been an object in the projection of canals to bring them as near towns as possible, when, after all, a cartage, or removal, must take place. In bringing a canal near a large town the difficulties and inconveniences are very great, valuable property is wasted, communication (which is very essential) is cut off, the situation for the business is limited, no farther extension can take place; even this may be in a situation where there is an embankment, of course inconvenient to load in and out, or if deep cuttings, the wharfs are then expensive in excavating. This rail-way would waste valuable land near a large town in a trifling comparative degree to a canal, communication would be free, on and over every part of the same; nor would there be any particular limited situation for wharfs or warehouses: hence large towns would derive benefit in every part near which the road would be extended, carriages would not be liable to break down, nor would the wear of tiers, or any part, be put out of order by violent shocks. The easy repairs of carriages on such a road will certainly bear no comparison to those on common roads. The iron rail-ways in use, wherever they are upon and cross a turnpike-road, are inconvenient; these, on the contrary, form not the least impediment.

Specification

Specification of the Patent granted to TIMOTHY COBB, *of Banbury, in the County of Oxford, Woollen-manufacturer; for an Improvement in the Manufacture of a certain Kind of Piece Goods, called Shag or Plush.*

Dated February 21, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Timothy Cobb do hereby declare that my said invention of a certain kind of piece goods, called shag or plush, consists in the combining in the warp called the pole or pile of yarn, made from Spanish or other wool of a short staple, prepared by carding, roving, and spinning, in the common method now used in the manufacture of wool into yarn for weaving into cloth, by which the harshness, inseparable from shags made of the usual materials, is removed, the surface rendered softer, and the article of a more pliable nature.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

In the article described by the above specification, is combined the finest Spanish wool with cotton, so as to unite the valuable properties of each, and at the same time avoid what is objectionable in goods composed entirely of either. It is not so liable to be soiled, and discharge its colour, as goods made of cotton alone. It possesses the durability of shag without its harshness, having a soft and agreeable surface, besides the great advantage of not shrinking when wet or washed.

Explanation of the Principles on which the Purification of Fish-Oil may be performed, and of the Uses to which it is applicable. By ROBERT DOSSIE, *Esq.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Premium of 100*l. was voted to Mr.* DOSSIE, *for this Communication in the Year* 1761. *It has lately been much enquired after; and is, on that account, now published.*

THAT the fetid smell of fish-oil is chiefly owing to putrefaction, it is unnecessary to shew; but though this be the principal cause, there is another likewise, which is, ustion or burning the oil, occasioned by the strong heat employed for the extracting it from the blubber of the larger fish, and which produces a strong empyreumatic scent that is not always to be equally removed by the same means as the putrid smell, but remains sometimes very prevalent after that is taken away.

In order to the perfect edulcoration of oils, there are consequently two kinds of fœtor or stink to be removed, viz. the putrid and the empyreumatic; and the same means do not always equally avail against both.

The putrid smell of fish-oil is of two kinds; the rancid, which is peculiar to oils; and the common putrid smell, which is the general effect of the putrefaction of animal fluids, or of the vascular solids, when commixed with aqueous fluids.

Fish-oil has not only rancidity, or the first kind of putrid smells peculiar to oils, but also the second or general kinds; as the oil, for the most part, is commixed with the

the gelatinous humour common to all animals, and some kinds with a proportion of the bile likewise; and those humours putrifying combine their putrid scent with the rancidity of the oil, and, in cases were great heat has been used, with that and the empyreuma also.

The reason of the presence of the gelatinous fluid in fish-oil is this: that the blubber, which consists partly of adipose vesicles, and partly of the membrana cellulosa, which contains the gelatinous fluid, is, for the most part, kept a considerable time before the oil is separated from it, either from the want of convenient opportunities to extract the oil, or in order to the obtaining a larger proportion; as the putrid effervescence which then comes on, rupturing the vesicles, makes the blubber yield a greater quantity of oil than could be extracted before such change was produced; and the vesicles of the tela cellulosa, containing the gelatinous matter, being also burst from the same cause, such matter being then rendered saponaceous by the putrefaction, a part of it mixes intimately with the oil, and constitutes it a compound of the proper oleaginous parts and this heterogeneous fluid.

The presence of the bile in fish-oil is occasioned by its being, in many cases, extracted from the liver of the fish; which is not to be so profitably done by other means as by putrefaction; and the bile being consequently discharged, together with the oil from the vessels of the liver containing them, combines with it, both from the original saponaceous property of the bile, and from that which it acquires by putrefaction.

This holds good particularly of the cod-oil, or common train, brought from Newfoundland; which from its high yellow colour, viscid consistence, and repugnance to burning well in lamps, manifests sensibly the presence of bile and the gelatinous fluid; which latter, by the saponaceous

ceous power of the bile, is commixed in a greater proportion in this than in any other kind of fish-oil.

A tendency to putrify, or at most but in an extremely slow manner, is not an absolute property of perfect oils in a simple or pure state; but it is a relative property dependant upon their accidental contact or commixture with the aqueous fluid. This is evident from the case of oils concreted into a sebaceous form; which being perfectly oleaginous and uncombined with any water, except such as enters into their component parts, will not putrify unless water, or something containing it, is brought in contact with them. But the fluid animal, and most vegetable oils, being compounded of perfect oils with other mixed substances, either sub-oleaginous or gelatinous, have always a putrescence *per se*, or tendency to putrify, without farther admixture of aqueous moisture. This commixture of heterogeneous matter in fish-oil, particularly of the gelatinous fluid and bile, gives rise to a further principle of purification than *simple edulcoration*, or the removing the fœtor; for the presence of such humours in the oil renders it subject to a second putrescence *per se*, supposing the first corrected; makes it unfit for the purpose of the woollen manufacture, as the heat through which this is in some cases employed, causes this matter to contract a most disagreeable empyreuma. It also prevents its burning in lamps, as well from its viscidity as from the repugnance which the presence of water gives to all oleaginous matter. It is therefore necessary to free the oil from this heterogeneous matter; after which it can be subject only to the rancid putrescence, or that which is proper to oils as such.

The substances which have been or may be applied to the removing or preventing the effects of putrescence, are, acids, alkalies, metallic calces, neutral salts, ethe-

real

real and essential oils, vinous spirits, water, and air. With respect to acids, though they may be applied with effect to the removal or prevention of putrefaction in mixed, animal, and vegetable substances, yet they have not the same efficacy when employed in the case of oils; for in a small proportion, without the subsequent aid of alkalies, they rather increase than diminish the fœtor, and in a large proportion they coagulate the oils, and change their other properties as well as their consistence. Though they might therefore be employed with the assistance of alkalies, yet requiring a more expensive and complex process, and not being moreover necessary, as the same end may be obtained by the use of alkalies only, they may be deemed improper for the purification of animal oils for commercial purposes. Alkaline substances, both salts and earths, are the most powerful instruments in the edulcoration of oils; but as their action on putrid oils, and the method of applying them to this end, are not the same in both, it is proper to consider them distinctly.

Of alkaline salts it is the fixed kind only which are proper to be used for the edulcoration of oils. Fixed alkaline salts, in a dissolved state, being commixed with putrifying animal substances, appear to combine with the putrid matter, and mixing with some of the principles, form instantly volatile alkaline salts. On the less putrid they seem to act, after their combination, by an acceleration of the putrescent action, till they attain the degree which produces volatile salts. This is evident by the sensible putrid ferment and smell which appear after their commixture; but which gradually abating, the oil is rendered sweeter, much lighter-coloured, and thinner.

Their great use in the edulcoration of fish-oil arises, therefore, from their converting such parts of the gela-

tinous

tinous fluid and bile as are highly putrified instantly into volatile salts, and causing a rapid putrefaction of the other parts; by which means the oil is freed from them by their dissipation. They do not, however, equally act on the parts of the oil on which the empyreumatic scent depends, unless by the assistance of heat; for when they are commixed with the oils without heat, in proportion as the putrid smell diminishes, that becomes more sensibly prevalent. The ultimate action of lixiviate salts on animal oils, except with respect to the empyreuma, seems to be the same either with or without the medium of heat; for the same urinous and putrid smell, gradual diminution of the colour, and fetid scent, happens in one case as in the other, except with regard to the acceleration of the changes; and such salts, where the purification is required to be made in a great degree, are a necessary means, as they are more effectual than any other substance that can be employed.

The use of lixiviate salts alone is not, however, the most expedient method that can be pursued for the edulcoration of oils, for several reasons. If they be used alone, cold, in the requisite proportions, they coagulate a considerable part of the oil, which will not again separate from them under a very great length of time; and when they have destroyed the putrid scent, a strong bitter empyreumatic smell remains. The same inconvenience, with relation to the coagulation of part of the oil, results when they are used alone with heat. The super-addition of common salt, (which resolves the coagulum and counteracts the saponaceous power of the lixiviate salt, by which the oil and water are made to combine) is therefore necessary: and the expense arising from the larger proportion of lixiviate salt, requires it to be employed if no other alkali be taken in aid, and renders

ders the junction of alkaline earths with it extremely proper in the edulcoration of oils for commercial uses. Lime has also an edulcorative power on animal oils; but it has also so strong a coagulative action, that the addition of a large proportion of alkaline salts becomes, when it is used, necessary to reduce the concreted oil to a fluid state; and therefore this substance alone is not proper for that purpose. The combination of lixiviate salt with lime, or the solution commonly called soap-lye, has an effectual edulcorative action of fetid oils; but it makes a troublesome coagulation of part of the oil, if no common salt be employed, and must be used in such large proportion, if no alkaline earth be added, as renders the method too expensive.

Lime has a power of combining with and absorbing the putrid parts of the gelatinous fluid and bile, when commixed with oil; and effects, either with or without heat, a considerable edulcoration of fetid oils; but it combines so strongly with them, either cold or hot, that the separation is difficult to be effected, even with the addition of brine; and the oil, when a large proportion of it is used, can scarcely be at all brought from its concreted to a fluid state, but by an equivalent large proportion of lixiviate salt: the use of lime therefore, alone, is improper, or even in a great proportion with other ingredients. But when only a lesser degree of edulcoration is required, a moderate quantity, conjoined with an equal or greater weight of chalk, which assists its separation from the oil, may, on account of its great cheapness, be employed very advantageously: it will in this case admit of precipitation from the oil by the addition of brine. It may be also expediently used, when lixiviate salt is employed with heat for the most perfect purification of oils; for it will in that case give room for the diminishing of the

quantity of lixiviate salt, though the proportion be nevertheless so restrained as not to exceed what the proportion of lixiviate salt (just requisite for the edulcoration) can separate from the oil.

Chalk has an absorbing power similar to lime, but in a less degree, on the putrid substance of oil; it does not, however, combine so strongly with the oil as to resist separation in the same manner, and is therefore very proper to be conjoined either with lixiviate salts or lime, as it renders a less quantity of either sufficient, and indeed contributes to the separation of the oil from them.

Magnesia alba or the alkaline earth which is the basis of the sal catharticus, and the singular earth which is the basis of alum, both have an edulcorating power on fetid oils; but, like lime, have too strong an attraction with them to be separated so as to admit of the reduction of the oil from the concreted state to which they reduce it; and therefore, as they are not superior in efficacy to lime and chalk, but much dearer or more difficult to be obtained, they may be rejected from the number of ingredients that are proper for the purifying of oils, with a view to commercial advantages.

Sea-salt has an antiseptic power on the mixed, solid parts of animals; but used alone, or dissolved in water, it does not appear to lessen the putrid fœtor of oils, but on the contrary rather increases it. If, after their commixture with it, they are subjected to heat, it rather depraves than improves the oils; but though by its own immediate action on them it conduces so little to the edulcoration of oils, yet it is a medium for the separation of water, and the alkaline substances requisite to be employed to that end. It is of great utility in the edulcorative processes: for when alkaline salts or earths combine with the water necessary to their action on the oils, or them-

themselves form coagulums or corrections with it, a solution of salt will loosen the bond and dissolve the close union; so that the oil being separated will float on the aqueous fluid, while the earth, if any be in the mixture, will be precipitated and sink close together to the bottom of the containing vessel.

Sal catharticus, Glauber's salt, nitrum vitriolatum, tartar, and other neutral salts, though they counteract putrefaction in the mixed or solid parts of animals, seem to have little effect on oils with respect to their edulcoration, and cannot therefore be ranked amongst the substances proper to be used for that purpose.

Lead reduced to the state of a calx, either in the form of minium or litharge, has a strong edulcorative power on fetid oils, and is indeed applied to that end, with respect to one kind of vegetable oil, for a very bad purpose, considering its malignant qualities on the human body.

In the case of train-oil, which will scarcely ever be considered among the esculent kinds in this country, the same objection against its use would not lie; and employed either with or without heat, it is a powerful absorbent both of the putrid and empyreumatic parts that occasion the fœtor.

As however there may be some prejudice against its use, even in any way, and as it is not absolutely necessary, I have not given it a place among the ingredients of the processes I recommend.

The ochrous earth of iron, commonly called red ochre, has an absorbing power on the putrid parts of oil, but combines so strongly, that the separation is tedious even with the addition of brine; if, nevertheless, it be added when chalk and lime have been some time commixed with the oil, as in process the first, it will promote the edul-

corative intention, and will subside along with them; and, as it has some advantage without increasing the expense, unless in the most inconsiderable degree, its use may be expediently admitted in that process.

Essential and ethereal oils are applicable to the prevention of putrefaction in the mixed and solid parts of vegetables, but are not so to the edulcoration of fetid oils; and if they had the desired effect, they would not, on account of their price, answer the commercial end, unless the due effect was produced by adding them to the oils in a very small quantity.

The same holds good of spirit of wine as of essential and etherial oils, both with respect to their efficacy and the expense.

Water has an edulcorative action on fetid oils, by carrying off the most putrid parts of the gelatinous fluid or bile, in which, as was above explained, the principal fœter resides, if the quantity added be large, and an intimate commixture be made of them by stirring them together for a considerable time: this only partially removing those heterogeneous putrescent substances, the remaining part soon acquires the same state, and the oil again grows fetid, though not to the same degree as before.

Water is, however, a necessary medium for the action of salts and the separation of alkaline earths and calces of metals, when they are employed for the edulcoration of oils, as will appear from a consideration of my processes.

Air edulcorates oil by carrying off the most putrid parts, which are necessarily extremely volatile. It may be made to act on them either by simple exposure of them to it, with a large extent of surface, or by forcing it through them by means of ventilators, as has been practised

practised by some dealers; but is now, I believe, neglected on account of their finding the improvement of oils by it not adequate to the trouble, as the gelatinous matter and bile, not reduced to a certain degree of putrefaction, being left behind, putrify again to nearly the same degree as before.

It appears from these several observations, that the cheapest ingredients which can be used for the edulcoration of train-oils, are lime and chalk, which may, with the addition of a proper quantity of solution of sea-salt or brine, be made to procure a separation of them from the oils, according to process the first, so as to answer for some purposes; that the lixiviate salt is the most powerful purifier of oils, and, with the assistance of chalk and brine, will, without heat, according to process the second, effect a very considerable degree of edulcoration; and that lixiviate salt used with heat, with the addition of lime and chalk, to save a part of the quantity which would otherwise be necessary, and of brine to procure a a quick separation, will perform an edulcoration sufficient for all commercial purposes, according to process the third; but that calcined lead and the ochrous earth of iron may, perhaps, be applied in some cases with advantage, where the oil is not designed for esculent use.

PROCESS THE FIRST. — *For purifying Fish-Oil in a moderate Degree, and at a very little Expense.*

Take an ounce of chalk in powder, and half an ounce of lime slacked by exposure to the air; put them into a gallon of stinking oil, and having mixed them well together by stirring, add half a pint of water, and mix that also with them by the same means. When they have stood an hour or two, repeat the stirring, and continue the same treatment at convenient intervals for two or three

three days; after which, superadd a pint and a half of water, in which an ounce of salt is dissolved, and mix them as the other ingredients, repeating the stirring, as before, for a day or two. Let the whole then stand at rest, and the water will sink below the oil, and the chalk subside in it to the bottom of the vessel. The oil will become clear, be of a lighter colour, and have considerably less smell, but will not be purified in a manner equal to what is effected by the other processes below given; though, as this is done with the expense of only one ounce of salt, it may be practised advantageously for many purposes, especially as a preparation for the next method, the operation of which will be thereby facilitated.

Process the Second.—*To purify, to a great Degree, Fish-Oil without Heat.*

Take a gallon of crude stinking oil, or rather such as has been prepared as above mentioned, and add to it an ounce of powdered chalk; stir them well together several times, as in the preceding process; and after they have been mixed some hours, or a whole day, add an ounce of pearl-ashes, dissolved in four ounces of water, and repeat the stirring as before. After they have been so treated for some hours, put in a pint of water, in which two ounces of salt are dissolved, and proceed as before: the oil and brine will separate on standing some days, and the oil will be greatly improved both in smell and colour. Where a greater purity is required, the quantity of pearl-ashes must be increased, and the time before the addition of the salt and water prolonged.

If the same operation is repeated several times, diminishing each time the quantity of ingredients one-half, the oil may be brought to a very light colour, and rendered

dered equally sweet in smell with the common spermaceti oil.

By this process the cod-oil may be made to burn; and, when it is so putrid as not to be fit for any use, either alone or mixed, it may be so corrected by the first part of the process, as to be equal to that commonly sold: but where this process is practised in the case of such putrid oil, use half an ounce of chalk and half an ounce of lime.

Process the Third.—*To purify Fish-Oil with the Assistance of Heat, where the greatest Purity is required, and particularly for the Woollen Manufacture.*

Take a gallon of crude stinking oil, and mix with it a quarter of an ounce of powdered chalk, a quarter of an ounce of lime, slacked in the air, and half a pint of water; stir them together; and when they have stood some hours, add a pint of water and two ounces of pearl-ashes, and place them over a fire that will just keep them simmering, till the oil appears of a light amber colour, and has lost all smell except a hot, greasy, soap-like scent. Then superadd half a pint of water in which an ounce of salt has been dissolved; and having boiled them half an hour, pour them into a proper vessel, and let them stand till the separation of the oil, water, and lime be made, as in the preceding process. Where this operation is performed to prepare oil for the woollen manufacture, the salt may be omitted; but the separation of the lime from the oil will be slower, and a longer boiling will be necessary.

If the oil be required yet more pure, treat it, after it is separated from the water, &c. according to the second process, with an ounce of chalk, a quarter of an ounce of pearl-ashes, and half an ounce of salt.

Observations

Observations on Process the First.

This process may be performed on any kind of fish or seal-oil that is putrid and stinking; and will improve it in smell, and generally render the colour lighter, if previously dark and brown: it will also conduce to render these oils fitter for burning, which are, in their crude state, faulty in that point; but it will not meliorate them to the full degree they admit of even without heat, and should therefore be practised when only a moderate improvement is required.

Secondly. When the oil is taken off from the dregs and brine, the dregs which swim on the brine should be taken off it also, and put into another vessel of a deep form; and on standing, particularly if fresh water be added and stirred with them, nearly the whole remaining part of the oil will separate from the foulness; or, to save this trouble, the dregs, when taken off, may be put to any future quantity of oil that is to be edulcorated by this method, which will answer the same purpose.

Observations on Process the Third.

First.—This is most advantageously performed on train-oil, called vicious whale-oil; and the more putrid and foul it may be, the greater will be the proportionable improvement, especially if there be no mixture of the other kinds of fish-oils, particularly the seal, which do not admit of being edulcorated perfectly by means of heat, but require other methods: but when the vicious oil is pure from admixture of others, however stinking it may be, the bad smell will be removed by this process duly executed, and the brown colour changed to a very light amber; and these qualities will be much more permanent

manent in this than in any crude oil, as it will not, from the degree of purity to which it is brought, be subject to putrify again under a great length of time, whether it be kept open or in close vessels.

The oil in this state will burn away without leaving the least remains of foulness in the lamp; and, being rendered more fluid than before, will go far ıer, when used in the woollen manufacture, than any other kind, and will be much more easily scoured from the wool.

If nevertheless there be any branches of the woollen manufacture which require the use of a more thick and unctuous oil, this may be rendered so by the addition of a proper quantity of tallow or fat, of which a certain proportion will perfectly incorporate with the oil, the fluidity and transparency being still preserved, as well as all the other qualities that render it suitable to the intended purpose. This may be most beneficially done by adding a proper quantity of the refuse grease of families, commonly called *kitchen-stuff*, which being put to the oil, when moderately heated, will immediately dissolve in it, and let fall also its impurities or foulness to the bottom of the vessel, and render the purified admixture a considerable saving to the manufacturers.

Secondly.—The different qualities and dispositions of different parcels of vicious oil with respect to edulcoration, render various proportions necessary of the ingredients to be used. The quantities stated in the above process are the least which will effect the end in general, and frequently greater will be required; but this may always be first tried; and if it be found, after six or eight hours simmering of the mixture, that no gradual improvement is making in the smell and colour, but that the oil continues the same in those particulars, and remains also mixed with the chalk and lime, and in a thick turbid

 state,

state, a fourth or third part of the first quantity of pearl-ashes should be added, and the simmering continued till the oil be perfect. As the quantity of the water is lessened by the evaporation, it is necessary to make fresh additions from time to time, that there may be always nearly the original proportion.

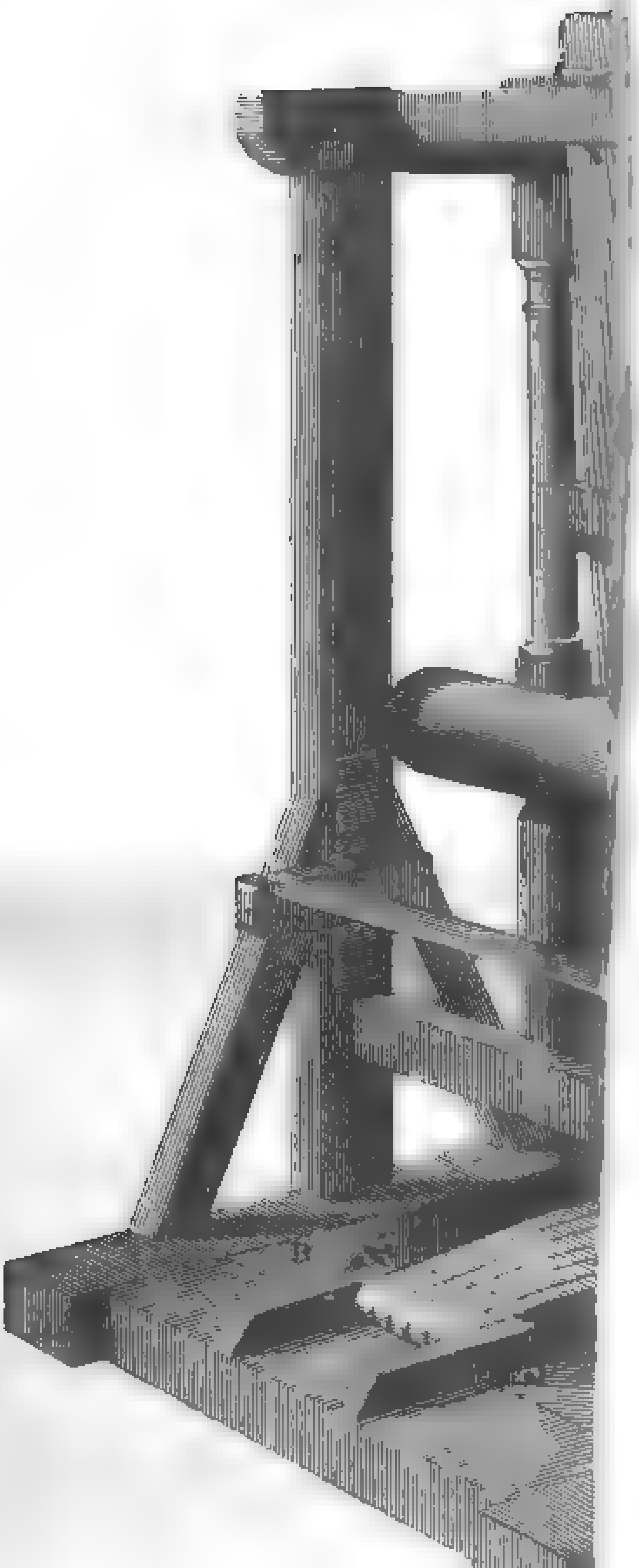
Thirdly.—If it be inconvenient to give the whole time of boiling at once, the fire may be suffered to go out and be re-kindled at any distance of time; and if, in such case, a small proportion of pearl-ashes dissolved in water be added, and the mixture several times stirred betwixt the times of boiling, it will facilitate the operation. The time of boiling may be also much shortened if the chalk, lime, and pearl-ashes, be added for some days before, and the mixture frequently stirred.

Process the Fourth, —*which may be practised alone, instead of Process the First, as it will edulcorate and purify Fish-Oil to a considerable Degree, so as to answer most Purposes, and for Process the Third, when the whole is performed.*

Take a gallon of crude stinking oil, and put to it a pint of water poured off from two ounces of lime slacked in the air; let them stand together, and stir them up several times for the first twenty-four hours; then let them stand a day, and the lime-water will sink below the oil, which must be carefully separated from them. Take this oil, if not sufficiently purified for your purpose, and treat it as directed in process the third, diminishing the quantity of pearl-ashes to one ounce, and omitting the lime and chalk *.

* The dregs remaining after the sundry processes above mentioned, will form an excellent manure, as has been since noticed in Dr. Hunter's Georgical Essays.

Description



Description of an improved Loom applicable to the weaving of Purses, Pockets, and Sacks; and of a Method of setting up Looms of all Kinds, so as to do their Work better than in the common Way.

By Mr. THOMAS CLULOW, *of Old Cock-lane, Shoreditch.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Twenty-five Guineas was voted to Mr. Clulow *for these Inventions.*

AN oblong frame A (see Plate III.) is laid down horizontally, and secured at the four corners with triangular braces B, B, B, B, to keep the frame properly square.

Four posts C, C, C, C, are fixed upright in mortise-holes on the above frame. The front posts are supported both back and front with diagonal timbers D, D, D, D, to keep the breast roll E from giving way in the least by the heavy stroke of the batten F F on the quarter or work: the two hinder posts G, G, are held firm by two diagonal supports H, H, within the loom, to bear against the counter weights I, I, and the great weight V, hanging on the work K, and the force of the batten F.

In a loom constructed on this plan, both strong and slight works may be made firm and good, without the loom having any shorings or supports; the advantages arising from which are the following, *viz.*

Poor indigent weavers being obliged to live in low-rented houses, the floors and party walls of the rooms where they weave are bad and weak, so that the common looms cannot be placed firm, and a man is perplexed to set up his loom in requisite order. If the loom be not set

up firm, and secured from giving way in the working of it, no work can be made strong and good. One great disadvantage is done away by the bottom frame that I use for fixing my loom upon, which can be placed by any common workman; whereas to set a loom up in the old method, requires great exactness and judgment to prevent the work from being damaged.

If, in the common way, a loom be not properly put in the square, and firmly shored, which it is difficult to do, the silk chases and cuts, the mind of the workman is harrassed for want of knowing the real cause of it, or having sufficient knowledge to correct it; therefore the work is spoiled for want of a trifling alteration in the loom, and the blame frequently laid upon the silk when the error lies wholly in the loom.

If a common loom be put in its proper square, and has not a firm shoring or support, the work or cloth has not the firmness which it ought to have, and which it will have in my method. It frequently happens that the shorings or supports are too long and slender, or the places weak which they are fixed against, which causes a trembling motion in the loom; and if the loom shakes only the 100th part of an inch (which is not more on a moderate calculation than the breadth of each thread shot into the work) it will take out that stiffness there ought to be in the work; for if the loom does not stand firm against the stroke of the batten, the work will lie hollow, be flimsy, and though it takes as much silk as good work, it does not look well, nor will sell for so much money: the poor weaver is therefore turned out of employment, not knowing where the error lies; and the employer suffers in his property.

If the shores to the common looms, after being placed, either fall by accident or through the continual shaking of

of the loom whilst working, which circumstances will sometimes happen in the middle of a piece of work being done, it is with great difficulty that the loom can then be put in square, or supported as it ought to be; therefore it occasions the work to be spoiled.

Besides these, other difficulties frequently occur to a weaver where the loom is not properly fixed, squared, and shored, which those persons conversant in weaving well know. I shall mention one material instance, where, if the loom is originally well set up in the common way, it may be liable to great disadvantage, *viz.* its situation in regard to light, which is a main point, as in that case it cannot be moved without great risk, if any work is in it; whereas, if the loom is made according *to my model*, the weaver may slide it to any exactness that is requisite, as a few inches moving will permit the light to fall on the work properly without injury to the work, as my loom is firm and squared, without requiring the aid of any shores.

Articles wove in this loom will be less liable to lose their contents than those whose seams are sowed with the needle, and be less liable to want repairs.

Method of weaving Sacks, &c. in the Loom abovementioned.

L, the seat of the loom.

M, the treadles, six in number, to raise the harness.

N, the counter-meshes to raise the tumblers O, moveable on a pin a little beyond their centre, and which act on the harness P, by raising such parts thereof as they are attached to at their extremities.

Q, the work in the loom.

R, the reed which strikes the shoot or weft close up.

S, the back beam on which the warp or thread is wound.

T, T,

T, T, the rods to preserve the crossing of the threads.

V, the main weight suspended by a lever U, from a bar W near its centre; the other end of the lever is fastened by a cord to the bottom frame of the loom at X.

Y, the rack on the working beam.

Z, the catch to hold the teeth of the rack.

To weave a sack, press down the second treadle on the right-hand side, and throw one shoot with the shuttle; then press down the second treadle on the left-hand side, and throw another shoot; then proceed in the same manner with the third on the right and the third on the left, till a sufficient quantity is made; then work the two outside treadles and two shoots.

In weaving sacks, it is necessary between the finishing of one sack and the commencement of another, to pass a thin slip of wood through the threads, in order to form a space between the two sacks.

Observations on the Means of enabling a Cottager to keep a Cow by the Produce of a small Portion of Arable Land.

From Essays on Miscellaneous Subjects.

By Sir John Sinclair, *Bart.*

THE following paper was drawn up for the consideration of the Board of Agriculture, who, in consequence of the observations therein stated, and the great importance of the subject, came to the following resolution:

Resolved, (June 9th, 1801,) that a premium of the gold medal be offered to each of the five persons, who shall, in the most satisfactory manner, prove by experiment, the practicability of cottagers being enabled to keep

keep one or two milch cows, on the produce of land cultivated with the spade and hoe only, and who shall send to the board, on or before the 1st of January, 1803, the best accounts of such experiments, detailing,

1. The expense of erecting the cottage, shed, and any other building thought necessary.

2. The expense of providing the stock and tools necessary.

3. The extent of land, and nature of the soil occupied.

4. The expense of digging and fencing the land.

5. The rent, taxes, &c. paid for the same by the cottager.

6. The course of cropping that has been adopted.

7. The quantity and value of each of the different crops.

8. How the cottager and his family are maintained, and how they manage to cultivate the ground, and to harvest the different crops.

9. How the cow is maintained during the year, and what profit is derived from it.

10. What profit is derived from pigs, poultry, and other articles.

11. How many days they were enabled to labour for other people. And,

12. How, on the whole, the plan has been found to answer?

IN several parts of the kingdom, as in Lincolnshire, Rutlandshire, &c. which are calculated for grazing, it is not unusual to give industrious cottagers as much land as will enable them to keep a cow, and sometimes two, or more, besides other stock; and it appears from the communications of Lord Winchelsea and others, to the Board of Agriculture, from the publications of the society

society for bettering the condition of the poor, and from a late interesting work printed by Mr. Arthur Young *, that such a system is productive of the happiest consequences. It is supposed, however, to be totally inapplicable to an arable district. I trust that such an opinion will not be admitted, without full consideration. Indeed, so far as I can judge, this advantageous system is to the full as well adapted for the one district as for the other. It requires unquestionably more labour on the part of the cottager, and of his family; at the same time, the occupation of so great an extent of ground is not so necessary in arable, as in grazing, countries; a circumstance, in various respects, extremely material.

In arranging the following plan, (which the reader will please to consider, merely as furnishing an outline, to be perfected by farther discussion and experiment), it is proposed to keep in view the following principles:

1. That the cottager shall raise, by his own labour, some of the most material articles of subsistence for himself and his family.

2. That he shall be enabled to supply the adjoining markets with the smaller agricultural productions; and,

3. That both he and his family, shall have it in their power to assist the neighbouring farmers, at all seasons of the year, almost equally as well as if they had no land in their occupation.

It can hardly be questioned, that, if it were practicable to have a number of cottagers of that description, in every parish, it would promote, in various respects, the interests of the public.

* Intituled, "An Inquiry into the Propriety of applying Wastes to "the better Maintenance and Support of the Poor."

I. *Extent*

I. *Extent of Land necessary.*

Unless the experiment were fairly tried, it is impossible to state exactly the extent of arable land requisite to enable a cottager to raise the articles generally necessary for the sustenance of himself and family, and to keep a cow, some pigs, and poultry. Much must depend upon the natural richness of the soil (though under the management about to be proposed, almost any soil would in time become fertile); on the nature of the climate; on the size of the cow; on the industry of the cottager; on the age and number of his family, &c. But I should imagine, that three statute acres and a quarter of good arable land, worth from 20 *s.* to 30 *s.* *per* acre, would be sufficient. It is proposed, that the three acres shall be under a regular course of cropping. The quarter of an acre ought, if possible, to be converted into an orchard, where the cow might occasionally pasture, and where a pond ought to be kept in good order, that it may have plenty of water at command. Were the land of a quality fit for lucerne, perhaps two acres and a quarter might be sufficient.

II. *Stock and Instruments of Husbandry.*

It is evident, that so small an extent of land, as either two or three acres, under cultivation, excludes all idea of ploughing *, and indeed, unless the cottager shall manage the whole, in the simplest and cheapest manner, there is an end to the whole system. It would require, indeed, four or five acres to keep a single horse, and the expense of purchasing horses, or even oxen, ploughs, and

* Ploughs might perhaps be hired; but, on the whole, the spade-culture is infinitely preferable, and I would much rather see a cottager hire persons to trench than to plough for him.

other instruments of husbandry, must be far beyond the abilities of a cottager; whereas with a spade, a hoe, a rake, a scythe, a sickle, and a flail, which are all the instruments really necessary, he is perfectly competent to the management of his little farm.

III. *Course of Crops, &c.*

The three acres, proposed to be cultivated, should be divided into four portions, each consisting of three roods, under the following system of management:

	Roods.
Under potatoes, 2 roods, under turnips, one *	3
Under winter tares, 2 roods, spring tares, one	3
Under barley, wheat, or oats	3
Under clover, with a mixture of rye-grass †	3
Total	12 Roods.

Other articles besides these might be mentioned, but it seems to me of peculiar importance to restrict the attention of the cottager to as few objects of cultivation as possible.

It is proposed, that the produce of the two roods of potatoes shall go to the maintenance of the cottager and his family ‡; and that the rood of turnips should be given

* I would also recommend a small quantity of flax, where the culture and management of the plant was known, to employ the females, particularly in winter, and to supply the family with linen.

† Some recommend the proportion, *per* acre, to be at the rate of one bushel of rye-grass to 12 lbs. of red-clover; others 14 lbs. of red-clover to half a bushel of rye-grass.

‡ By Sir John Methuen Poore's experiments, it was found that half a rood, or one-eighth of an acre, produced, for several years, as great a weight of potatoes as was sufficient for a family of four persons.—Four acres answered for 131 persons.

to

to the cow in winter, and during the spring, in addition to its other fare.

The second portion, sown with tares, (the two roods of potatoes of the former year, to be successively sown with winter tares, and the turnip rood with spring tares,) might partly be cut green, for feeding the cow in summer and autumn; but, if the season will permit, the whole ought to be made into hay for the winter and spring feed, and three roods of clover cut green for summer food.

The third portion may be sown either with barley, wheat, or oats, according to the soil or climate, and the general custom of the country. The straw of any of these crops would be of essential service for littering the cow, but would be still more useful, if cut into chaff, for feeding it.

The fourth portion, appropriated to clover and rye-grass, to be cut green, which, with the assistance of the orchard, will produce, on three roods of land, as much food as will maintain a cow and her calf for five months, namely, from the end of May, or beginning of June, when it may be first cut, to the beginning of November, besides some food for the pigs. It is supposed, that an acre of clover and rye-grass, cut green, will produce 20,000 lbs. weight of food for cattle. Three roods therefore ought to yield 15,000 lbs. weight. A large cow requires 110 lbs. weight of green food *per* day; a middling sized cow, such as a cottager is likely to purchase, not above 90 lbs.; consequently, in five months, allowing 1,320 lbs. weight for the calf and the pigs, there will remain 13,680 lbs. for the cow *. Were there, however,

* These calculations are merely given as data for experiment. It must depend upon the season, whether the tares or the clover should be made into hay.

even a small deficiency, it would be more than compensated by the rood of land proposed to be kept in perpetual pasture as an orchard.

IV. *Mode in which the Family may be maintained.*

It is calculated, that three roods and eight perches of potatoes will maintain a small family of six persons, for about nine months in the year; but, according to the preceding plan, it is proposed to have but two roods under that article; for however valuable potatoes are justly accounted, yet some change of food would be acceptable; and the cottager will be enabled, from the produce of the cow, and by the income derived from his own labour, and from that of his family, to purchase other wholesome articles of provision.

V. *Manner in which the Stock may be kept.*

It appears from the preceding system of cropping, that ten roods of land, or two acres and a half, are appropriated to the raising of food for the cow in summer and winter, besides the pasture of the orchard; and unless the season should be extremely unfavourable, the produce will be found not only adequate to that purpose, but also to maintain the calf for some time, till it can be sold to advantage. It is indeed extremely material, under the proposed system, to make as much profit of the calves as possible, as the money thus raised will be a resource enabling the cottager to replace his cow, when a new one must be purchased.

For the winter provision of the cow, which is the most material, because summer food can be more easily procured, there is the produce,

1. Of about three roods of tares, or clover, made into hay.

2. Of three roods of straw, deducting what may be necessary for litter; and if dry earth be put into the cow's hovel, and removed from time to time to the dung-hill, little or no litter will be necessary.

3. Of one rood of turnips.

The whole will be sufficient for seven months in the year, namely, from the 1st November to the 1st June; and during the remaining five months, the pasture of the orchard, some of the winter tares, and the produce of three roods of tares, or clover and rye-grass, will not only suffice, but will furnish a surplus for the calf, if it is kept for any length of time *, and some tares or clover for the pigs.

The inferior barley, potatoes, &c. will of course be given to the pigs and the poultry.

VI. *Value of the Produce.*

The land thus managed, will certainly produce, by means of the extra industry of the family, and at a small expense, a most important addition to the income which the cottager may derive from his ordinary labour. For instance,

* In a pamphlet just published by Richardson, Cornhill, on the culture of potatoes, price 1*s.* the following mode of applying the refuse potatoes, to the feeding of calves, is strongly recommended.

" Take two gallons of small potatoes, wash them clean, put them " into a pot of boiling water sufficient to cover them, and let them " boil till the whole becomes a pulp: then add more water, and run " the whole through a hair sieve, which will produce a strong nutri- " tive gruel. At first use a very small quantity, warmed up with " milk, to make it palatable to the calf, and increase the quantity " daily, till it becomes equal. A quart of potatoe gruel, and a quart " of scald or skimmed milk, will be sufficient for a good meal, which " should be given warm three times a day."

1. The

	per Annum.		
	£.	s.	d.
1. The orchard (after the trees become fruitful) will probably yield	1	10	0
2. Three roods of turnips and potatoes . .	4	0	0
3. Eighteen bushels of barley, at 4 *s*. . . .	3	12	0
4. The cow and calf*	7	0	0
5. Hogs	3	0	0
6. Poultry and eggs	2	0	0
Total	£.21	2	0

Where wheat can be raised instead of barley, the profit would be still more considerable. Opinions will differ much, regarding the value put on each article, but that is of little consequence, as the total cannot be accounted too high.

VII. *Time required for cultivating the Land.*

The quantity of land intended to be cultivated, will not materially interfere with the usual labour of the cottager. It will only require to be dug once, and is then fit to be cropped. It is proposed, that only nine roods shall be annually cultivated, (the remaining three roods being under clover and rye-grass,) and nine roods may be dug in the space of about 558 hours, or at the rate of 62 hours per rood. This might be done at bye hours (more especially when the family of the cottager shall be somewhat advanced, and consequently more able to furnish assistance); but supposing that the digging, manuring, harvesting, &c. will require twenty entire days *per*

* According to Mr. Kent's calculations, a cow should produce six quarts of milk *per* day, worth 1*d*. *per* quart, equal to 3*s*. 6*d*. a week, or 9*l*. 2*s*. *per annum*; setting the profit of the calf against the loss sustained when the cow is dry: but it is better to be rather under than over the mark.

annum,

annum, in addition to the bye hours, and allowing sixty days for Sundays and Holidays, there will remain 285 days, for the ordinary hand labour of the cottager, which, at 1*s.* 6*d*, *per* day, would amount to 21*l*. 7*s*. 6*d*.; the earnings of the wife and children, may, at an average, be worth at least 4*l*. *per annum* more. This is certainly a low calculation, considering how much may be got during the hay and corn harvests: but even at that moderate estimate, the total income of the family will be as follows:

		£.	s.	d.
1.	Produce of the farm - -	21	2	0
2.	Labour of the cottager - -	21	7	6
3.	Earnings of the family - -	4	0	0
	Total	46	9	6

VIII. *Buildings.*

It is impossible to calculate the expense of building a cottage, as so much depends upon its size, the place where it is situated, the materials of which it is composed, the price of labour in the country, and a variety of other circumstances. On this important subject, much useful information is contained in the first volume of the Communications published by the Board of Agriculture. But it is proper to observe, that no expensive additional buildings will be necessary, in consequence of the proposed system. A shed or hovel for the cow cannot occasion any very heavy charge, and a small barn, of the simplest and cheapest construction, may be of use, not only for threshing the crop, but also for securing the hay, and making it to more advantage, in case the season should prove unfavourable; if the corn is put up in small stacks, the barn may be made of very moderate dimensions.

IX. *Rent*

IX. *Rent, and Balance of Income.*

The rents of cottages, and of land, vary so much in different parts of the kingdom, that it is difficult to ascertain an average. But if the cottage shall be stated at 3 *l.* *per annum*, the land at 25*s.* *per* acre, and the orchard at 10 *s.* the whole will not exceed 7 *l.* 15 *s.* The cottager will also be liable to the payment of some taxes, say to the amount of 1*l.* 5*s.* more. Hence the total deductions would be about 9*l.* leaving a balance in favour of the cottager of 37 *l.* 9 *s.* 6 *d.* Considering the cheap rate at which he is furnished with a quantity of potatoes, equal to several months' consumption, and with milk for his children, surely, with that balance, he can find no difficulty, not only in maintaining himself and family in a style of comfort, but also in placing out his children properly, and laying up a small annual surplus, that will render any parish assistance, whether in sickness or old age, unnecessary; and thus he will be enabled to preserve that manly and independent spirit, which it so well becomes a British cottager to possess *.

CONCLUSION.

Advantages of the proposed System.

I shall now endeavour briefly to explain some of the advantages which may be looked for with confidence, from the proposed system.

In the first place, the land possessed by the cottager would be completely cultivated, and rendered as productive as possible. The dung produced by the cow, the

* The different expense of fuel, in the various districts, will, it is evident, greatly affect the annual surplus.

pigs,

pigs, &c. would be amply sufficient for the three roods under turnips and potatoes; which would afterwards produce, 1, Tares; 2, Barley; and, 3, Clover; with a mixture of rye-grass, in regular succession, without any additional manure. The barley should yield at least 18 bushels, besides 3 bushels for seed; and if wheat or oats are cultivated, in the same proportion. The milk, deducting what may be necessary for the calf, and for the cottager's family, might be sold in its original state, if there shall be a market for it, or converted into butter, for the purpose of supplying the neighbouring towns or villages. Such cottagers also might certainly send to market both eggs and poultry.

2. It is hardly possible to suggest a measure more likely to promote the benefit of a numerous and valuable body of people. The system of keeping cows by cottagers, which has been found so advantageous in the grazing districts, may thus be extended over the whole kingdom; and indeed, if the above plan is found to answer, in place of four or five acres employed in feeding a single cow, it would be much better, even in the grazing counties, to restrict the land to a smaller quantity, under a tillage-mode of management; for thus not only the cow, but also the cottager himself and his family, would, in a great measure, be maintained by a less surface of soil.

3. It is of infinite consequence to establish the practicability of this system, as the means of removing a most unfortunate obstacle to the improvement of the country. It is well known to be the only popular objection to the inclosure of our wastes and commons, that, while uninclosed, a number of cottagers are enabled to keep cows, by the means of their common-rights, and that their cows

disappear when the commons are inclosed. But if so small a portion of land as $3\frac{1}{4}$ acres, when improved and properly cultivated, can enable a cottager to keep a cow, even to more advantage than with a right of common, which can hardly be doubted, as he is enabled to provide winter as well as summer food, there is an end to that obstacle to improvement. Indeed, if sufficient attention be paid to the principles above detailed, the situation of the cottager, instead of being deteriorated, would be materially bettered by the inclosure; and his rising family would be early accustomed to habits of industry, instead of idleness and vice.

I shall conclude with asking, if any one can figure to himself a more delightful spectacle, than to see an industrious cottager, his busy wife, and healthy family, living in a comfortable house, rented by himself, cultivating their little territory with their own hands, and enjoying the profits arising from their own labour and industry? or whether it is possible for a generous landholder to employ his property with more satisfaction, or in a manner more likely to promote, not only his own, but the public interest, than by endeavouring to increase the number of such cottagers, and encouraging, by every means in his power, the exertions of so meritorious, and so important a class of the community?

Plan

Plan of the proposed Cottage Farm, pointing out the Rotation of Crops in the different Lots.

Cottage.	The Orchard, or perpetual Pasture.	Pond.

Lot A. 3 Roods. 1 Year { 2 Roods Potatoes. 1 Rood Turnips.	Lot B. 3 Roods. 1 Year { 2 Roods Winter Tares. 1 Rood Spring Tares.
Lot C. 3 Roods. 1 Year—Barley, Wheat, or Oats.	Lot D. 3 Roods. 1 Year—Clover and Rye-grass.

The Rotation of Crops for Four Years.

Year.	Lot A.	Lot B.	Lot C.	Lot D.
1	Potatoes and Turnips.	Winter and Spring Tares.	Barley, Wheat, or Oats.	Clover and Rye-grass.
2	Winter and Spring Tares.	Barley, Wheat, or Oats.	Clover and Rye-grass.	Potatoes and Turnips.
3	Barley, Wheat, or Oats.	Clover and Rye-grass.	Potatoes and Turnips.	Winter and Spring Tares.
4	Clover and Rye-grafs.	Potatoes and Turnips.	Winter and Spring Tares.	Barley, Wheat, or Oats.

The rotation then begins as at first. Lot D might continue in natural grass the first season, to diminish the labour of that year.

The exact period when the different crops should be dug for, or sown, cannot be ascertained, because it varies so much in different counties; and depends upon the seasons; but, according to the above rotation, the labour of digging for the various crops is diversified as much as possible, so as not to interfere materially with the other occupations of the cottager. At no period would it be necessary for him to dig more than two roods in a month; and both he and his family will labour with much more satisfaction and dispatch when they work for themselves than for another. In case of necessity, the cottager might hire some of his neighbours to assist him in digging, which would be much better than hiring a plough. If it is found that a cottager, under this system, cannot work as a common daily labourer, it might at least answer for labourers by the piece, who are so extremely useful in all countries.

 On

On the successful Introduction of new Articles into Field Culture. By JOSEPH WIMPEY, *Esq.*

FROM HUNTER'S GEOGICAL ESSAYS.

IF in the idea of new articles be included those which have been transferred from the garden to the field, the number will be far from being inconsiderable. Turnips, potatoes, cabbage of different kinds, carrots, parsnips, &c. were cultivated for domestic uses, long before the time proposed; but the field culture of these articles for the feed of cattle, in any considerable degree, is quite a modern practice. The success which has attended the use of these articles, hath incontestibly established their great value and importance; but unfortunately their culture hath been hitherto much confined, and is very far from being generally practised.

Many kinds of grasses have likewise been strongly recommended as valuable improvements, which, having answered the sinister views of some of the recommenders, in selling their seeds at a great price, and upon trial being found greatly inferior to the spontaneous growths of this country, have very deservedly fallen into general disuse, and are no more thought of. There are two articles, however, commonly reckoned among the grasses, which must ever be distinguished and separated from those that have been found useless, that is to say, Sainfoin and Lucerne; these merit more attention and care than have been usually bestowed upon them, and would well repay the farmer for all his expense and trouble, if bestowed with discretion and judgement, for they certainly might be made improvements of the most valuable kind.

Sainfoin has been sown pretty extensively in some parts, but not so generally by far as it deserves. It generally succeeds well upon chalk, from whence it has been very erroneously concluded, that it will not thrive in a deep soil. It is supposed a hard substratum of chalk prevents the deep penetration of the roots, which is the natural bias of the plant, for it is not known to what depth it would descend in a friable soil that would yield to the perpendicular descent of its root. From hence it is strangely concluded, that the plant in such soil is exhausted of its vigour by the luxuriance of its own roots; and that the produce of the herbage on the surface is small in proportion as that of the roots is large. This notion, repugnant as it certainly is to common sense and reason, as well as to experience and observation, is firmly believed and maintained by men of very good abilities; so invincible are prejudices early imbibed, and supported by local customs, and habits of practice long established.

I am clearly of opinion, that there are few arable farms in the kingdom which are not capable of great improvement by planting of sainfoin, more especially those which are but poorly provided with good pasture and meadow land. The poorest fields of such farms might, by proper management, be brought to produce good crops of sainfoin; and land, the natural intrinsic value of which is not more than from 2*s*. 6*d*. to 5*s*. an acre *per annum*, might certainly, at a very moderate expense, be made worth from 20*s*. to 40*s*. This would prove an unspeakable advantage to the occupier as well as to the owner of a farm that is almost wholly arable, as it would enable him to keep a much larger number of milch-cows, and hogs in proportion, and by these means greatly increase the quantity of manure for the improvement of his corn-fields.

The

The greatest enemies sainfoin has to encounter, are grass and weeds: these in land that is tolerably good, soon overcome and destroy it, unless the farmer will take the trouble, and be at the expense of keeping it clean. But this is by no means so formidable an undertaking as hath been generally thought, provided the land be very well cleaned and pulverized before the seed be sown, and provided also it be sown in rows from fifteen to eighteen inches distant, which is as near as it ought to be sown, if intended for a lasting plantation. At those distances, the intervals between the rows may be kept perfectly clean with a small plough and a narrow drag of about twelve inches wide. With these instruments several acres may be cleaned in a day, and supposing this to be done three times in a summer, the expense would amount but to a trifle. My drag is twelve inches wide, and proves extremely useful in drilled crops of every kind, as also in those of what nature soever that are planted in rows.

Lucerne, under a similar management, would be a very great improvement on arable farms. Indeed an opinion generally prevails, that it requires a much better soil than is commonly found. Crops of all kinds are more abundant on a good than on a bad soil, if they are kept clean; but it is a very erroneous opinion, that lucerne will thrive only on rich land. It may be raised to great advantage on land of a very indifferent quality, by the same means as above recommended for sainfoin, and the same care to keep it free from grass and weeds. I have cut five good crops off such land in one summer, after having been planted five years, without a grain of manure of any kind, except a small sprinkling of turf ashes the second year after sowing the seed. A few acres of either, or both these grasses, with a few more of potatoes, cabbage, or turnips, would enable the occupier of an arable

farm

farm to keep from eight to twelve, or even twenty milch-cows, according to the size of his farm, though he should not have an acre of meadow or pasture belonging to the same.

Of articles which are truly useful and entirely new, we know of few that have been introduced within the time mentioned. The turnip-rooted cabbage is a truly valuable root, which was accidentally discovered about twenty years ago, and has been cultivated with great success by several gentlemen, and strongly recommended by them to the attention of the farmer. Both its roots and greens are exceeding good food for cattle, but what constitutes its principal excellence is its extreme hardness, for it resists the violence of the most vigorous seasons and severest frosts. When the common turnip and hardiest cabbage have been entirely cut off and destroyed, this has continued its fine verdure, and supplied the kitchen with greens, and the cattle with sweet and wholesome roots, even till the middle of May.

Another new article, which has been very lately introduced, is the *Mangel Wurzel*, or Scarcity Plant. From the success some few gentlemen have had in its cultivation, it seems to promise to be of the greatest utility for the feed of cattle. However, it is very little known as yet, it being supposed that not one farmer of a thousand has so much as ever heard of the name. It is generally agreed to be a species of the beet, of which there are many. The seeds of both have exactly the same appearance, and the leaves and roots differ only in colour and size, for the manner of their growth is exactly the same; but the leafage of the new sort is said to be much more luxuriant and abundant, and the roots vastly larger.

In

In order to discover the most advantageous mode of raising this plant, I sowed, or rather set, a quantity of the seed in several different ways in April last. The beginning of July, the outside leaves had obtained their full growth, some of which I broke off and offered to the horses and cows, who eat them very freely; but when offered to the pigs, they seized them with great eagerness, and devoured rather that eat them. The pigs are still fed with them daily, and constantly prefer them to every kind of green food or root that can be given them. Breaking off the leaves takes up much time, and is very troublesome; therefore when the outside leaves are fully come to maturity, I cut the whole clean off, about an inch and a half above the ground, whence fresh leaves shoot up very freely. My experience is yet too small to speak with confidence; but, it seems to me, an acre of this plant, if it takes well, would be sufficient to keep twenty pigs very well for five or six months, say from July to November, or December, inclusive.

The improvements made for cultivating turnips for the feed of sheep and fattening of cattle, is so generally known, and extensively practised, that it seems unnecessary to say any thing on that head. I will, however, beg leave to observe here, that the opinion generally maintained, that turnips are an improper food for milch-cows, as it spoils the cream and butter by impregnating the milk with the strong flavour of the turnip, appears to me, by repeated experiments, to be ill-founded. The two last winters and springs my milch-cows lived chiefly on turnips, and their butter was found not only as good as my neighbours, whose cows ate none, but was even preferred to it. They say their opinion is grounded on experience as well as mine. The difficulty, I apprehend, lies here; my turnips are pulled, brought home, and given

given to the cows in the yard; their cows have been used to be turned in upon them, where they pick up the charlock and other weeds which abound among them, for they are never hoed; and to this, and not the turnips, I am persuaded, the disagreeable flavour of the milk is owing. It must be observed that the turnips should be given to the cows while they are fresh and firm, for all food when grown putrid and corrupted is unwholesome, and doubtless would affect the juices of the animals that eat it.

Of all the articles we have mentioned, or that are yet known, perhaps very few can equal, and none excel the *Potatoe.* The inestimable value of this root is hardly to be conceived. It is not only an almost constant dish in great and opulent families, but in times of scarcity and dearness, the poor are almost wholly subsisted by it. There are many poor families in this neighbourhood, who, the last winter, ate them three times a day with a little salt, without a morsel of meat or bread with them. It is true they have been long in use for the food of man, but it is of late date that they have been extensively cultivated for the feed of cattle; and even now I am pretty clearly of opinion, that if they were much more generally cultivated than they have hitherto been, the farmer would find his account in it, especially where a substitute is much wanted in the winter and spring seasons for the support of his cattle.

Hogs are immoderately fond of potatoes, and will live entirely upon them till they are fit to put up to fatten for pork or bacon; and then, boiled and mixed with barley or pease meal, they fatten on them speedily and make fine meat. Another use I have put them to, which has been little practised, or thought of; that is, for the feed of milch-cows. Three gallons a day, half at night, and half in the morning, is quite sufficient to keep a large cow in

full milk, and the milk as sweet and as good as in the summer months. Nothing excels them for the feed of cows which are fatting their calves for the butcher. I fatted four last spring, which were sold from 35s. to above 40s. a calf, which was double what I ever sold any for at this place before. Last year, after taking them up, several calves, about six or seven months old, were turned into the potatoe ground with the cows; they fed upon them as kindly as so many pigs, and preferred them to every thing else they could meet with.

I have had no experience of their use as food for horses; but I have been assured by a gentleman who resided some years in Ireland, that he kept his hunter, a stone horse, entirely upon them instead of corn. He ate nothing else, excepting hay between his feed of potatoes, as other horses; yet he was as fat, as healthy, and nearly as strong, and as full of spirits, as if he had given him all the corn he could eat.

Discovery of a particular Principle in Sandarac; and Method of preparing a good Varnish from that Substance.

By M. Giese, of Augsburg.

From the Journal de Chimie.

It has been long observed that, in making varnish of sandarac with spirit of wine, a considerable quantity of matter is deposited in the varnish, and could not by any means be dissolved. It is this matter which the author proposed to examine.

On a certain quantity of residue of sandarac, M. Giese poured highly rectified spirit of wine, and exposed the mixture

mixture to a steady heat for several days. At the end of that time no perceptible solution had taken place, whence he concluded that the matter was insoluble in alkohol. He therefore submitted it to the following experiments.

A select portion of sandarac, finely pulverized, was dissolved warm in 16 parts of highly rectified spirit of wine. After three days the solution was still far from complete, notwithstanding the great proportion of spirit that had been employed.

The solution was poured off from the sediment, four parts of spirit of wine were again poured to the latter and digested warm, for two hours; but not the least diminution was observed in the quantity of the residue. The mixture was filtered and the concrete matter dried. It weighed about a fifth part of the sandarac employed for the experiment, had a light grey appearance, was very brittle, and easily pulverised. The author submitted it to the following experiments.

Experiment I. When brought near the flame of a candle the matter instantly took fire, and burned with a bright blaze, emitting a thick smoke. The residue was a black shining matter, resembling resin.

A small quantity of this residue, when exposed with alkohol to a violent heat, was dissolved; the solution became white with the addition of water.

Experiment II. Water boiled with the residue could not dissolve the smallest portion of it.

Experiment III. On the residue was poured ether by sulphuric acid. It was quickly and completely dissolved by it. This solution possessed the following properties;

1. It deposited on bodies that were covered with it a white sediment similar to lime.

2. When poured into alkohol the dissolved matter was precipitated.

3. But when poured into water it was not precipitated, and only after the volatilization of the ether it was observed that the water was covered with a white shining pellicle, of a resinous appearance.

Experiment IV. On the residue was poured concentrated sulphuric acid. It first assumed a red colour, and by degrees it dissolved in the acid with which it formed a thick liquid, of a reddish-brown colour.

1. A part of this solution was poured into water; a quantity of whitish flakes was instantly separated, and collected on a filtre.

2. These flakes being treated with alkohol were almost entirely dissolved in it, and again separated from it by the addition of water.

Experiment V. Nitric acid poured on the residue was incapable of dissolving it cold; and it was only after a certain time, and with the aid of heat, that this acid dissolved a small portion of it.

From these experiments it results that the substance remaining from the solution of sandarac in alkohol is a principle differing from resins, and that sandarac is a composition of that substance and resinous matter. This residue has hitherto been thrown aside as useless by the makers of varnish; as it burns readily, and emits a smell by no means disagreeable, the author proposes to introduce it as an ingredient in the composition of perfumes for fumigation.

M. Giese concludes with a few directions relative to the making of a good varnish with sandarac.

1. The proportions should be two parts of alkohol to one of sandarac.

2. The sandarac must not be pulverised.

3. The solution should be made cold, and should be promoted by frequent agitation.

By

By observing these rules, the varnish, when applied, is almost always prevented from becoming of an opaque white in drying; which is occasioned by a portion of the fresh substance, which, when the sandarac is pulverised, is held in solution by means of heat and the aid of resin.

On oleaginous Hydrogen. By Professor PROUST.

From the JOURNAL DE PHYSIQUE.

THE memoir of the Dutch chemists suggested to me the idea of making a few experiments on the gas obtained by distillation from olive oil. If the consequences which I have ventured to draw from them be not perfectly correct, they will at least contribute to extend the knowledge of this new order of facts, and to multiply the means of studying them better.

I call this gas oleaginous, because I conceive that its great weight, its white, dull, smoaky flame, its strong smell, and in particular the property of becoming lighter by passing several times through alkohol, prove a simple solution of oleaginous vapor in carbonic hydrogen.

Even the purest oil invariably gives carbonic acid with oleaginous gas. Berthollet very justly observes, that a certain proportion of oxygen must be allowed to exist in oils, which is likewise confirmed by their continual absorption of it. Perhaps some may be inclined to class this acid among the principles of the mucilaginous substance, which Scheele separated from it by means of oxyd of lead; but if on the one hand the nature of the ingredients of the operation be considered, and on the other that of the sugar

sugar of oils, I think it will not be at all unreasonable to suppose that this sugar is entirely formed by the oxyd during the boiling.

It is free from every metallic substance, for it does not disturb hydro-sulphurated water; but there is a marked distinction between it and the other vegetable sugars, as it is incapable of fermenting, corrupting, or becoming mouldy. I have kept three or four ounces of it above ten years; it is of the consistence of a very clear syrup, and the hottest weather has never made the slightest alteration in it. In short, I am strongly inclined to believe that this sugar is rather a new product than a substance separated from oils.

Distilled oil exhibits characters to which little attention has been given. It is converted into volatile, odorous or essential oil, by doubtless dissolving a certain quantity of carbonic hydrogen. The following are some of its properties.

When heated with water in a retort, a portion passes over in distillation. It has a very strong but disagreeable smell, and is so light as to belong to the class of volatile oils, since its weight to that of olive oil is only as 91 to 100. It floats on alkohol which easily disolves it. It boils as soon as essence of turpentine, and if a lighted taper be held to the mouth of the matrass, the vapor takes fire like that of the substance just mentioned.

I have not strictly examined the liquid acid which accompanies distilled oil: I shall only introduce here a fact relative to its history. If soap be distilled till the oil is destroyed, the saline residue, which I imagined would be carbonate, is sebate of pot-ash. It is crystallisable, and sulphuric acid instantly produces with it that subtile vapor, denominated sebacic acid. It is converted into the oleaginous hydrogen, which held in solution the artificial essential

essential oil, of which I spoke in the beginning. But the heat suddenly siezing the portion of the oil it contains, it passes from the gaseous state to that of carbonated hydrogen, in the same manner as ether, alkohol, radical vinegar, essence of turpentine, &c.

I shall conclude this subject with an experiment made by Rouelle in his lectures, and which I likewise exhibit in mine, because, besides being an agreeable spectacle, the explanation of its causes is closely connected with the theory of inflammations.

Pour half a spoonful of olive oil into a small brass crucible heated to a faint red, or to a certain degree which the operator must previously endeavour to ascertain. A large column of white smoke instantly rises from it which takes fire at the top, that is, at the distance of four or five feet from the crucible. If on the contrary, it takes fire below near the crucible, the latter is too hot. It is necessary to wait a few moments, and the phenomenon is exhibited in all its magnificence. Wax produces the same effect, but I think there is less certainty with it than with oil.

On the Disoxydation of Iron.

The most simple truths of chemistry are not always the most easily explained in public instruction. For instance, nothing is more evident to the most numerous auditory, than the surcharge of oxygen which iron carries along with it in the experiment of the canon, because there is not a spectator who cannot ascertain it with his own eyes, and perfectly convince himself of what is intended to be shewn him. But when, in the connection of ideas and proofs you arrive at those which relate to the disoxydation of the above metal, you must give up facts, and substitute suppositions, because the former are

not

not capable of being easily executed in public. In very few instances indeed can a degree of heat be applied to the oxyd of iron sufficient to disoxydate it, and not even to reduce it easily by fusion. But this difficulty may be partly surmounted in the following manner.

Heat for the space of an hour a mixture of an ounce of load-stone, and two penny-weights of charcoal, in a small luted glass retort, the luting of which projects two inches from the bottom. It is placed immediately on the grate of the furnace, and its neck projects from it through the door of the fire-place, closed with pieces of brick and earth, which keep the retort in its place. If the neck is not long enough to reach into the pneumatic vessel, which for this purpose should be a bowl or soup-dish, with a plate of lead, perforated with holes, another must be fastened to it, and luted with paper and paste.

This done, cover the grate and the retort with charcoal, with the usual precautions. By this disposition it is subjected to a much more violent heat than if it were placed on the bars. Carbonic acid and carbonic oxyd may then be obtained with the greatest facility.

When the retort is cold, it is found nearly filled with a spunge of pure iron, which assumes metallic lustre if rubbed with a polished substance. This spunge is torn with difficulty; it is plain that there is a connection of all its parts, notwithstanding their distance from each other. It takes fire with the blow-pipe, and emits sparks. The load-stone lifts it up entire. It may be used for producing hydrogen with sulphuric acid, and indeed every one must be convinced upon touching it that it is iron restored to its original state. As in this operation carburet is formed, the solution of iron has the bituminous smell, which characterises that of brass.

If,

If, instead of charcoal of fir, blood, well washed, be added to the oxyd of charcoal, ammoniacal carbonate is deposited in the neck of the retort. I have explained the origin of this production in my second memoir on Prussian blue. The solution of iron then with potash yields phosphate at the first moment of its precipitation. The bituminous smell of solutions of brass, and likewise gas, may be obtained from fresh charcoal of blood; if treated with sulphuric acid, it takes fire at the mouth of the matrass. The reason is so evident, that it would be superfluous to give any account of it.

Four inches of this gas and one of oxygen do not take fire in the canon with the charge of a pocket electrophorus; neither is this effect produced with two, nor even three of oxygen. My object in these experiments was to see whether charcoal or oil would be precipitated. But with four inches of oxygen, or equal parts, inflammation takes place; and an agreeable surprise is produced when upon turning the cock the gaseous residue, instead of being diminished, is found on the contrary increased to thirteen or fourteen inches. This sudden dilatation is attended with another fact not less curious, the explanation of which instantly occurs to every one who recollects Monge's observation on an atmosphere more or less compressed. A cloud or thick fog fills the canon in proportion as this residue escapes from the compression in which it was before retained. Let us now examine the eight inches of mixture augmented in bulk to thirteen or fourteen by inflammation.

It is poured through lime-water to purify it; and it is observed scarcely to disturb it, and sometimes not at all. It likewise keeps up its dimensions to thirteen or fourteen inches within a few lines.

If a light be held to it, you discover that it is no longer oleaginous hydrogen. Its blue flame descends slowly, and

and it is consumed without the least detonation. It has, besides, but very little smell, extremely different from that of oleaginous hydrogen.

This gas burned with oxygen is wholly converted into carbonic acid, and no longer affords the phenomenon of dilatation, however small may be the quantity of oxygen that is mixed with it.

The following are the conclusions that I have ventured to draw from these results.

I think this residue cannot retain the smallest portion of oxygen after inflammation, otherwise it would burn rapidly, whereas the contrary takes place.

Four inches of oxygen usually consume seven inches and a half of pure hydrogen in my eudiometer; and as the remaining gas in the experiment contained a very small quantity of carbonic acid, the four inches must have consumed at least seven of hydrogen, if it was in the usual state of dilatation in which it is kept by the pressure of the atmosphere.

Four inches of oleaginous hydrogen would therefore, according to this calculation, contain seven inches of pure condensed hydrogen in the space of four. Besides, our residue, after the combustion of four inches of oleaginous gas, is suddenly changed into 13 or 14 inches of carbonic hydrogen. It must hence be concluded that our seven inches of hydrogen, compressed into the space of four, held in solution a quantity of oil capable of being transformed, by the assistance of a powerful heat, into 13 or 14 inches of carbonic hydrogen. I say a powerful heat, because, in fact, that alone can convert oil into carbonic hydrogen.

Hence I conclude, that when four parts of oleaginous gas are inflamed with the same quantity of oxygen, nothing is actually burned but hydrogen.

Essay

Essay on the Fecula of Green Plants.
By Professor Proust.

From the Journal de Physique.

Hilaire Rouelle was the first that discovered in the fecula of plants a substance analogous to the gluten of flower. Since his time the existence of the latter has not appeared doubtful, because there are few chemists who have not themselves ascertained its real characteristics; but the fecula, the basis of which it forms, is, in the opinion of Fourcroy, only an imaginary substance; or at least too superficially observed to be reckoned amongst the immediate products of vegetables. He even goes so far as to suppose that the albumen, an animal production, which nobody before him suspected to be in plants, is the substance intended as a substitute for the glutinous part of the green fecula.

Are the albumen and gluten contained in a combined or separate state in the juice of plants? Such was the question I proposed to myself, and which I shall endeavour to resolve in this sequel to my observations on *the System of Chemical Knowledge.*

To spare the reader the trouble of referring to the work, I shall transcribe the passage in which the author collects the facts, and the arguments from which he drew his conclusions. This passage is the more remarkable, for the contradiction between his manner of characterising other vegetable productions, and that of the chemists of the day.

"Rouelle, junior, who had particularly examined and compared it with animal matters, asserted, that he had found it in coloured feculæ; and especially in that called

the green fecula of plants. But the term fecula, given indiscriminately to the fibrous matter contained in the juice of plants, and to the starch, having led chemists to consider the latter as part of the residue of solid vegetable substances, there is reason to believe that it was only from analogy, and on account of some equivocal properties, that Rouelle imagined the green matter contained gluten; at least the experiments which have been made since that time, and those which I have frequently repeated on coloured feculæ, furnished no confirmation of this assertion; and no actual proof has been adduced that gluten is one of the principles of the latter fecula."

The term fecula, says Fourcroy, given *indiscriminately* to the fibrous matter contained in the juice of plants and to the starch, having caused the latter to be considered as the residue of solid vegetable substances, &c.

I shall first remark that this opinion is not correct. The chemists of the present day will certainly not agree with M. Fourcroy, that the confusion occasioned by the improper use of words, of which modern chemists have so justly complained, produced any inaccuracy in the ideas of our predecessors. Our instructors called things by improper names, it must be admitted, but they confounded them no more than we.

Even at the time when every vegetable deposit was considered a fecula, they never were so far misled by the resemblance of the names as to assimilate starch to the residue of the solid parts of plants. In the first place, we know of no residue to which the chemists could reasonably have compared it: and, secondly, if any of them had taken the green fecula for a residue, yet there was not one who was not perfectly aware of the difference between this fecula or residue, and starch; and since no such confusion appears in their works, it is unjust to reproach

proach them with it; for it will be sufficient to look into those of Rouelle, Macquer, Baumé, Sage, Parmentier, &c. to be convinced that the word fecula never led those authors into assimilations so contradictory to their judgment, as that of ranking under one head green fecula, the residue of solid particles and starchy substances.

We shall now pass to the green fecula, and will venture to assert, that in the laboratories, in pharmacy, and still less by a chemist so celebrated as Rouelle for accuracy of investigation, the broken stalks of green plants were never confounded with the beautiful soft liquid expressed from their leaves, with that emulsive product, which, whilst fresh may be strained through a cloth, and which by its excessive fineness and the brilliancy of its colour, so far surpasses herbaceous filaments.

Besides, if the fecula were a substance homogeneous with the rest of the plant, if it were only a portion that differed from the remainder merely in being more bruised, would not trituration be sufficient to convert that remainder into fecula? When the pestle bruises a fresh herb, it destroys its texture, but does not pulverise it.

This contusion is, in some instances, so perfectly different from a dry pulverisation, that its fecula can by no means be compared with a humid powder. If you crush an aqueous juicy plant, for instance a *sedum*, with a roller, on marble, the juice expressed will afford fecula. It is not to trituration that a fecula owes its silky softness, the impalpability which distinguishes it from powder; it is in its nature molecular, and may even be crystallized in the fibrous interstices in which it is deposited by vegetation.

Rouelle asserts, says Fourcroy, that feculæ contain a principle similar to animal matters, &c. Rouelle went farther:

farther: not satisfied with simple assertions, he proved it not by analogy or equivocal properties, but by a series of convincing facts, by results which combined the principal characteristics then known, and even still known, to exist in animal substances. Whence could Rouelle otherwise have drawn his analogy, to compare as he did green fecula to the gluten of wheat? What have those two products in common in their appearance, that can lead to comparisons between them? To discover points of resemblance, it was necessary to examine their composition, their chemical properties, and that was what this laborious chemist actually did. It was the approximations deduced from analysis that served as the basis of the memoir he presented on green fecula, and of which no mention is made in the *System of Chemical Knowledge*; doubtless, because its illustrious author, convinced in his own mind that Rouelle confounded albumen with gluten, conceived that an account of his mistake was of no importance to the history of chemistry.

Rouelle however found in the fecula of sorrel a product, possessing in such a powerful degree the chemical properties of albumen, that he used it as a powerful argument, for calling the attention of his age to a substance so nearly resembling an animal production. As he afterwards extracted it from a plant, which according to Foucroy furnishes not the least vestige of albumen, it cannot now be denied any more than it could then, that Rouelle first discovered in juices and green feculæ a product, which if it cannot be called albumen, yet so perfectly possesses all the properties that have exclusively called the attention of chemists to the latter, that it appears equally entitled with albumen itself to distinction in the history of their discoveries.

To

To the same penetration and the impulse of that genius which led to these discoveries, he was indebted for that of the astonishing similarity between caseum and gluten, after they have both undergone the kind of fermentation which transforms them into that cellular, odorous and savory composition called cheese. In this extraordinary result, gluten more nearly resembles the other the more carefully it has been washed. Macquer, who ascribes part of these changes to a residue of starch, had not an accurate idea of the subject; starch, a substance always inactive in fermentation, either of bread or beer, and even in germination, would only tend to retard that of gluten, and consequently could only partially destroy those characters whence Rouelle deduced the analogy of those two products.

And even their analysis far exceeds the limits assigned them: for when gluten has exchanged its state as an insipid and viscous mucilage for the cheesy state; when it has passed through all those degrees of fermentation necessary for arriving at that state, it is found equally impregnated with those sharp and burning salts which constitute the principal recommendation of Roquefort cheese; salts which have no connection with what is added, and which are found equally powerful in the curd after being washed, and left to ferment of itself.

In the cheese of gluten, in fact, as in that of animals, pot-ash and sulphuric acid lead us to recognize the ammoniac and vinegar which Vauquelin discovered. Can then ammoniacal acetate be one of the seasoning ingredients of cheese? I only know that alkohol applied to the strongest cheese deprives it of all taste. An analysis undertaken on that principle might furnish curious results; but let us return to green feculæ; let us examine them by the

lights

lights of modern chemistry, and let us in particular endeavour to discover whether albumen actually exists where Beccari and Rouelle discovered gluten.

Green Fecula.

I. Heat produces a change in fecula capable alone of giving it a decisive character as to its nature. I allude to that concrescibility of which there are few examples among vegetable products; to that agglutination which attaches its particles to each other, and gives it the appearance of a cheesy curd. Although fecula, before this change, may be easily strained through a cloth, it cannot after being heated; a particular kind of crispation has deprived it of its tenuity; but heat does not coagulate the fibrous texture; in this respect the fecula has not the least resemblance to the broken stalks of green plants.

II. The fecula separated from the juices by filtration, acquires in drying an elastic and horny consistence. It is softened with difficulty in hot water; but it does not become perfectly soft even in a month; notwithstanding the moisture, it preserves its horny quality. If bent, it returns to its position; but absolutely refuses to crumble: these are qualities scarcely remarked at all in the dried woody pulp.

The feculæ of green and white cabbages, of cresses, of hemlock, &c. do not, however, lose their property of coagulating by heat. If into water heated to between 50 and 60 degrees, you plunge two corresponding matrasses, one with diluted fecula, and the other with the water and white of egg, the fecula hardens and coagulates in flakes, such as are seen in a juice set upon the fire to clarify; but at that temperature the albumen does not even lose its transparency.

III. The

III. The green fecula is nearly of the same weight as water, for that of plants, which are not acid, often requires more than eight days to settle.

Into three glasses, of equal dimensions, put fecula, washed and diluted. To the first add a small quantity of alkohol, a few drops of acid to the second, and place the third between the other two, for the purpose of comparison. The two first are completely precipitated in less than half an hour, whilst the precipitation of the third is scarcely begun; thus alkohol and acids are capable of coagulating the fecula, but have not the same effect on the woody residue.

IV. One hundred parts of the dried fecula of hemlock, yield to alkohol 15 or 16 of green resin. When taken out of the repeated infusions to which it must be subjected, it remains of an earthy grey colour, and alkohol is incapable of bleaching it. Sage, who was perfectly acquainted with feculæ, found that some yielded one-third of their weight in resin; to separate it, they must be thrown, moistened, into spirit of wine, which penetrates and attacks them on all sides; but this is effected with much greater difficulty when they have been rendered horny by desiccation.

TO BE CONCLUDED IN OUR NEXT.

Method of preparing muriatic Ether with simple Acid.
By M. Basse, *Apothecary at Hameln.*

From Scherer's Journal der Chemie.

Melt marine salt in a crucible, and keep it in fusion an hour, or till the whole of the water of crystallization be dissipated. Put twenty ounces of this salt into a tubulated retort, adapt to it a curved tube, and plunge the

the tube to the bottom of a bottle with two necks, into which have been poured ten ounces of alkohol, marking 100 on Richter's alkoholimeter. (This alkohol must be prepared, by mixing in a retort three parts of highly rectified spirit of wine with one part of pot-ash, melted and pulverized, whilst hot, and it is distilled till diminished one half.) When the whole is well luted, pour into the retort, in quantities of half a penny weight at a time, ten ounces of highly concentrated sulphuric acid. After each introduction of acid close the tube carefully, and put in no more fresh acid, till the salt has quite ceased bubbling. The cork of the other neck of the bottle must be taken out from time to time, to suffer the air condensed above the alkohol to escape.

After all the acid is introduced, place the retort on a sand bath, and heat it gradually till all the muriatic acid be expelled. During this part of the operation care must be taken frequently to cool the bottle containing the alkohol by wrapping a wet cloth round it.

The alkohol thus charged with acid, is then put into a retort and distilled to one half. Shake the distilled liquid with a sufficient quantity of alkaline ley to carry off the acid, decant the superpatant portion which is ether, and keep it in bottles well corked. From the above-mentioned quantities, two ounces and a half of ether are usually obtained.

M. Basse asserts that by operating with thermoxydated muriatic acid, light alkoholic ether can never be obtained, but only a heavy oleaginous ether which instead of floating on water falls to the bottom of that liquid.

Transactions

Transactions of Societies for promoting useful Knowledge.

Paris.

Philomathic Society.

M. TOURDES, Professor of the School of Medicine at Strasburg, last year announced that the fibre of blood, separated from the lymph and aqueous humour, nearly pure, coagulated, and still retaining a heat equal to 30 degrees of Reaumur, exhibited, when submitted to the action of the Galvanic pile, an actual contraction, perceptible with a magnifying glass.

This observation, extremely important for the study of physiology, was calculated to excite the attention of persons interested in that science; yet it remained in a kind of oblivion till M. Circaud, a student of medicine at the School of Paris, made the same remark without knowing that it had been already announced. He therefore bestowed the utmost attention on his experiments, and exhibited before several naturalists, and physiologists, the discovery which he imagined he had made.

Some of the members of this Society have actually witnessed this manifest contraction of the fibre, obtained from the blood of an ox killed a few minutes before. The contraction of the coagulated mass was visible to the naked eye; and the movement was perfectly similar to that observed in the muscular fibres.

The pile was composed of 60 disks of zinc, as many of copper and pieces of cloth, impregnated with a solution of muriate of soda. The fibre was at the heat of about 32 or 33 degrees of the centigrade thermometer. The contraction lasted about 60 seconds, after which it

entirely ceased. This experiment did not succeed the two first times that it was tried.

Mr. Mushett some time since announced that iron, submitted to the action of heat, in a close crucible, was converted into steel, and melted; and that it might then be poured off. He attributed this alteration to a combination of carbon, proceeding either from carbonic acid decomposed by iron at that powerful degree of heat, or from charcoal reduced to gas, and introduced into the inside of the crucible.—M. Collet Descotils, in order to satisfy the doubts that might be entertained of the above circumstance, so contrary to M. Clouet's experiments on the conversion of iron into steel by calcareous carbonate, and M. Guyton's on the same, by means of diamond, determined to repeat Mr. Mushett's experiments.

Three experiments, made with every possible precaution to separate the iron from every substance of the nature of charcoal, convinced M. Collet Descotils that whenever that was the case, the nature of the iron was not changed, and that when steel was formed it was only by accident. He likewise observed, that iron is by no means so difficult to be melted as has hitherto been imagined, having found that it ran in a very short time in all his experiments.

Society of Arts and Sciences at Utrecht.

This Society has proposed the following prize-question for the year 1803.—What is the true nature of electric matter? Is it a compound? What are the chemical changes that it undergoes when united with other bodies, and those which it produces in those bodies.

The prize, which is to be adjudged on October 1, 1803, consists of 30 ducats; and memoirs are to be addressed to Dr. Luckman at Utrecht.

Dublin

Dublin Society.

Premiums were lately adjudged, by the Dublin Society, to Mr. John Templeton, of Belfast, and Dr. Scott, of Dublin, for the discovery of native Irish plants, not hitherto described in any botanical work. To the former gentleman a premium was awarded for the discovery of a new species of rose, found in different parts of the counties of Down and Derry; and to the latter, for the discovery of two species of mosses growing on rocks in the vicinity of Balbrigan, county of Dublin; the first so near the sea as to be covered by it at high tides, the other growing among the mountains southward of Swadlinbar, on the banks of a rivulet, the soil of which was formed from decayed argillaceous schistus; and likewise for his discovery of a vegetable substance found growing in detached lime-stones in the bed of a rivulet in Queen's county.

The Museum of this Society, in addition to the collection more immediately connected with the great national objects of that body, is daily augmenting by the contributions of its members and others, so as already to present a collection of natural and artificial curiosities, highly interesting to the mineralogist, naturalist, and antiquary. Some very curious additions were lately made to it by Sir Walter Synnot and the Honourable Captain Stratford; the former having presented the Society with some Etruscan vases, several Roman lamps, sacrificial vessels, coins, &c.; together with several rare curiosities in South Sea Cloth, and natural history. An Anas Egyptiaca, or Egyptian goose, in high preservation, has been acknowledged from the latter gentleman.

Intelligence relating to Arts, Manufactures, &c.

Tanning.

MR. Davy, Professor of Chemistry in the Royal Institution of Great Britain, in a paper lately read to the Royal Society, has described the processes usual in the art of tanning, entered at large into a chemical investigation of the nature of the agents employed in the process, and detailed a number of ingenious experiments, undertaken expressly for the purpose of ascertaining the mode of their operation.

Agriculture.

A course of lectures, explaining the application of the principles of chemistry to the various operations of agriculture, has been prepared by Mr. Davy; and the introductory lecture has been read before the board, at their house in Sackville-street.

Destruction of Bugs.

Numerous methods have been employed, and many of them with very little or no effect, for the destruction of those troublesome insects—bugs. M. Gatte, an apothecary of Como, has discovered a mixture, which is recommended in preference to every other, as capable of destroying not only the insect itself, but also the nits. This composition is tincture of cantharides, prepared with an ounce of good alkohol and two penny-weights of cantharides. An infusion is made of these two substances cold, at least twenty-four hours, and in a glass vessel, well closed, and shaken from time to time. This tincture must not be filtered, and must be shaken when used, that the sediment may be mixed with the liquor. It is sufficient to dip a brush in it, and to rub the places to which the insects retire.

Stereotype

Stereotype Printing.

Earl Stanhope has lately been much employed in bringing to perfection an improved mode of printing. His invention, though in some respects similar to the French stereotype, is said to be very superior to it, with regard to neatness, accuracy, and cheapness.

Aërostation.

It is said that the art of guiding air-balloons has been lately discovered at Berne, in Switzerland; and that an experiment had been made of it near Seedorf, which is shortly to be repeated in England, the secret of the discovery having been purchased by a native of this country.

Patent Lamps.

Messrs. Smethurst and Paul, who have just obtained the King's Patent for lamps and reflectors made on a new principle, have lately made an experiment of their invention in New Bond-street. From the increased quantity of light which they afford, and the more equal manner in which it is distributed, this invention promises to be of great public utility.

List of Patents for Inventions, &c.

(Continued from Vol. II. Page 472.)

William Bainbridge, of Little Queen-street, Lincoln's-Inn-Fields, Middlesex, Musician; for improvements on the flagelet or English flute.
Dated April 1, 1803.

William Boond, of Manchester, Lancashire, Cotton-manufacturer; for a new-invented manufacture of mixed and

and coloured cotton-velvets, velveteens, velverets, thicksets, cords, and other cotton piece goods, commonly called fustians. Dated April 5, 1803.

Richard Francis Hawkins, of Woolwich, Kent, Gentleman; for a method of applying a certain power to the working of ships and other windlasses, ship and other winches, cranes, and other purposes, to which the same hath never before been employed. Dated April 5, 1803.

John Leach, of Merton Abbey, Surrey, Calico-printer; for improvements on steam-engine boilers; which improvements are applicable to boilers in general. Dated April 7, 1803.

Daniel Paulin Davis, of Bloomsbury-square, Middlesex; for a method of cleansing and sweeping chimnies. Dated April 11, 1803.

John Todd, of Bolton, Lancashire, Cotton-spinner; for a method of weaving and manufacturing woollen, cotton, linen, silk, and worsted cloths or stuffs; and also certain improvements on, and additions to, the machines used in weaving, by means of looms wrought by water, steam-engines, or any other power. Dated April 14, 1803.

William Horrocks, of Stockport, Cheshire, Cotton-manufacturer; for improvements on the loom for weaving of cotton, and other goods, by steam or water. Dated April 20, 1803.

Samuel Day, of Charter House Hinton, Somersetshire, Esquire; for an engine or time-piece, which he denominates, "*The Watchman's Noctuary, and Labourer's Regulator.*" Dated April 20, 1803.

James Hall, of Mellor, in the parish of Glossop, Derbyshire, Weaver; for improvements upon looms. Dated April 27, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XIV. SECOND SERIES. JULY 1, 1803.

Specification of the Patent granted to WILLIAM SPEER, *of the City of Dublin, Esquire; for an Improvement in the Construction of Hydrometers.*

Dated August 2, 1802.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Speer do hereby describe and ascertain the nature of my said invention and improvement, and the manner in which the same is to be performed, that is to say: I construct my hydrometer, as usual, of a ball, or hollow metallic part, to which is affixed a short stem with a load or weight, and diametrically opposite a longer stem for the purpose of graduation. The figures and dimensions of those several parts may be varied according to the well-known principles of this instrument; but the peculiar advantages of my improvement consists in the figure and method of graduating the stem; by means of which the gradations of strength of spirits at any known temperature can be seen, at once,

by immersion of the instrument, without the necessity of changing weights, by trial, or making any computations, or refering to any tables or sliding-rule, or other instrument whatever. I accomplish these purposes by constructing the upper stem in the form of a polygonal prism, of such dimensions that the whole of the said stem shall float above the surface of the water, at the temperature of thirty-five degrees of the thermometer of Fahrenheit. And the surface of the water shall intersect the lowest line of graduation upon one of the faces of the prism. And upon the said face I mark lines of graduation at the several stations to which the instrument has been found to be immersed, and to float in known mixtures of water and ardent spirit, at different strengths, at the temperature of thirty-five degrees aforesaid, above or under proof, up to the strongest, which can be produced by distillation. And I mark the said graduations on the stem by numbers, denoting the ultimate results or strengths commonly known by the term *per centages*, which said results have heretofore been ascertained by computation instead of direct inspection, as is done by the instrument with my improvement. And farther, in explanation of the term *per centage*, I here observe, that a spirituous liquor is said to be ten *per cent.* or any other given quantity over hydrometer-proof, when it is so strong that one hundred gallons of the said spirit will admit of an addition of ten gallons of water to reduce it to the strength of proof, and it is said to be ten *per cent.* under proof when one hundred gallons of the spirit contains ten gallons more of water than the same quantity of proof-spirit contains. And, lastly, I engrave at the upper end of the said face, the figures 35, to denote that the graduations on that face of the prism are applicable to spirits at that temperature, or number of degrees.

And

And moreover, upon the next contiguous face of the prism, I form and apply, by the means aforesaid, a similar graduation for an higher temperature, such for example as the temperature of forty degrees. And again, upon the face or side next contiguous to the last-mentioned face or side, I form and apply a similar graduation for a still higher temperature, such for example as the temperature of fifty degrees; and in this manner I graduate the several faces of my stem, so that the face last graduated shall be applicable to the highest ordinary temperature, as for example seventy degrees. The number of sides of the polygon may be greater or less, according to the number of temperatures respectively, to which the determinations are required to be made; but I adopt and recommend eight sides as the best adapted for the general purposes of revenue and commerce, so that each side shall bear a scale of *per centages* of spirit, differing in temperature, by two degrees, namely, beginning at 35 degrees and ending at 70 degrees. And to prevent any error which might possibly arise from an unskilful operator reading off the strength upon a wrong face of the instrument, I apply to the stem a small index, which embraces the same, and can be slided upwards and downwards to any part thereof, so as to point at the proper division. This index, which is of a different colour from the stem itself, constitutes part of the weight of the instrument above the fluid, but it is by no means a trial weight, for it is put on from the indication of temperature before the instrument is immersed at all. And farther, although it is very easy, from the contiguity of the divided faces, for each temperature upon the eight-sided instrument to read the result for the intermediate temperatures to a degree of precision fully adequate to the purposes of revenue and trade; I do nevertheless

make and apply, as an addition to the said improved instrument, (to be used or not, at the pleasure of the operator,) two other indexes, which, being lighter than the first-mentioned index, do cause the instrument to shew the strengths at two equal intermediate temperatures between those marked upon any contiguous face of the general scale. Thus, for example, supposing the temperature fifty degrees, nothing farther would be required but to place the index No. 1 on the side marked fifty, and immerse it in the fluid, of which it will at once shew the strength; but if the temperature be 51 or 52, I use the next lighter index, marked No. 2, which will cause the graduations to indicate strengths for the temperature $51\frac{1}{2}$; or in case the temperature had been 53 or 54, then the index No. 3 would have been to be applied, and the said face would then indicate strengths for the temperature $53\frac{1}{2}$, so that the result by the instrument will be true for the intermediate temperatures within half a degree; and even this small difference, if attended to, or thought of any importance, may be obtained by holding the jar containing the spirit a few moments in the hand.

And in the construction of an instrument for the immediate purposes of revenue and trade, I do recommend, and in practice, make the graduations on the stem to comprehend only those *per centages*, or strength, which are met with in the spirits usually dealt in in commeree, instead of beginning my graduations as low as water, near which strength no spirits are made or sold; or of carrying the said graduations up to the very highest alcohol, which is, comparatively, an article of little sale or transfer. By which means, I render my instrument more convenient, and the divisions more open and close. And with regard to the higher or lower strengths I would recommend another stem to be applied to the same instrument,

instrument, as hereinafter described. And, lastly, in this my new improvement of the hydrometer, and the method of graduating the same, since I do not confine myself to the number of sides in the prism, or stem, but make them as numèrous as the intended precision of experiment may require, I do also apply the same method of graduation to a cylindrical stem, which (as mathematicians well know,) may be considered as a prism, with an infinitely great number of sides. In this construction my lines of division, beginning from the lowest point, (as for water at thirty-five degrees), are passed obliquely upwards round the stem, and intersect certain straight lines drawn at equal distances from each other up the stem, which, by their intersection with the former oblique lines, afford certain points of graduation which answer to the several temperatures. And by this means, when the temperature is known, the immersion of the instrument will shew, by the intersection of the surface of the fluid, and one of the oblique lines on the very line of that known temperature, what may be the strength of the spirit. Or, otherwise, I make the stem of any figure whatever, of equal dimensions throughout its length, and instead of the flat sides of a prism, I divide the surface into longitudinal compartments by lines drawn lengthwise thereon. And I make my several scales of graduation as herein before described within. And upon the said several compartments, and in all the before mentioned constructions, wherein the same may be thought necessary, or desirable, with regard to the intermediate degrees, (instead of using different indexes as aforesaid) I alter the weight of the instrument, before immersion, by inserting four small pins in holes in the load or counterpoise below, or, if preferred, in the top of the upper stem, one of which pins being taken out causes

causes the instrument to become lighter, for one of the intermediate degrees of temperature; and two of the said pins being taken out produce a change answerable to two degrees of temperature. Having as above described the use and application of my invention to the ascertainment of the degrees or *per centages* of the strength of spirits at the temperature of from thirty-five to seventy, both inclusive; I now proceed to shew by what variation of my hydrometer, the degrees of strength, greater or less than those above mentioned, may be ascertained. And this I accomplish in the following manner: that is to say; from forty *per cent* over proof, at the temperature of 55 or thereabouts, up to alcohol or pure spirit. I use a short stem instead of that above described, which I remove on this occasion, screwing on the latter in its stead, and which being lighter, the immersion of the instrument is diminished, and thereby adapted to the shorter stem; and on this short stem I mark the different gradations or *per centages* of strength, in like manner as I have herein-before mentioned in relation to the other stem, and which being duly attended to, no further description is necessary. In like manner I adapt the instrument to the ascertainment of the strength of spirits of a weaker quality than those first above mentioned, by putting on a longer stem instead of that first described, and by graduating such longer stem, so as to indicate the gradations or *per centages* of strength of the spirit to be examined: and in order to prevent evasion in the two last-mentioned cases, I think it proper to add, that though I have mentioned a shorter and longer stem, yet the same purposes may be answered by using in the one case a lighter, instead of a shorter stem, and in the other by using a heavier instead of a longer stem. In witness whereof, &c.

Specification

Specification of the Patent granted to THOMAS WILSON, *of Bishop Wearmouth, in the County of Durham, Engineer; for uniting, combining, and connecting, the Metallic Patent Blocks of* Rowland Burdon *, *for the Construction of Arches.* Dated July 23, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Thomas Wilson, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and declare that my new-invented methods of uniting, combining, and connecting the metallic patent blocks of the said Rowland Burdon, for the construction of arches, are, first, instead of uniting the blocks by bar-iron on the outside of the arms and bolts fastened with cotterels or forelocks, as described in the specification of the said Rowland Burdon's invention, inrolled in his Majesty's high court of chancery, the 10th day of October, 1795, my method is to insert dowels or slots into the ends of the arms of blocks at the points of bearing, and to bring the blocks into close contact by driving wedges through the blocks and dowels, or slots, thereby combining the component parts of each rib in a more firm and substantial manner than has heretofore been practised, and considerably diminishing the draft or thrust of the arch. Secondly, instead of connecting and combining the ribs by means of hollow tubes, as described in the said Rowland Burdon's said specification, my method of connecting and combining the ribs is, by introducing between the blocks at the points of bearing, cross bars from rib to

* For the specification of Mr. Burdon's patent see the fifth volume, page 361, of the first series of this work.

rib,

rib, with apertures therein of sufficient size to admit the dowels or slots which connect or combine the blocks together to pass through the same; by which means the ribs are kept in their required position, and the blocks do not bear against each other, but are kept in close contact with the cross bar, against which they abut, and are connected together by the dowels or slots, and wedges.

As a farther illustration of my second method, the following particulars, with the drawings in the margin, are descriptive of it, as applied to the construction of the iron bridge which I am now erecting over the river Thames at Staines.

Fig. 1, (Plate IV.) represents a dowel.

Fig. 2, two wedges of malleable iron.

Fig. 3, part of a cross bar.

Fig. 4, end view of a block.

Fig. 5, two cast metal blocks, united together by the dowels *a, a, a, a*, and wedges *b, b, b, b*, which dowels pass through the aperture in the cross bars *c, c*.

The distance between the holes in the dowels being about a quarter of an inch less than that between the holes in the arms for receiving the wedges; by driving the wedges from each side of the blocks, the cross bars and blocks are brought into close contact. The arch of the bridge is a segment of a circle, whose chord or space is 180 feet, its versed sine or height 16 feet, and its breadth 27 feet. It consists of 6 ribs, and each rib is composed of 39 blocks.

In witness whereof, &c.

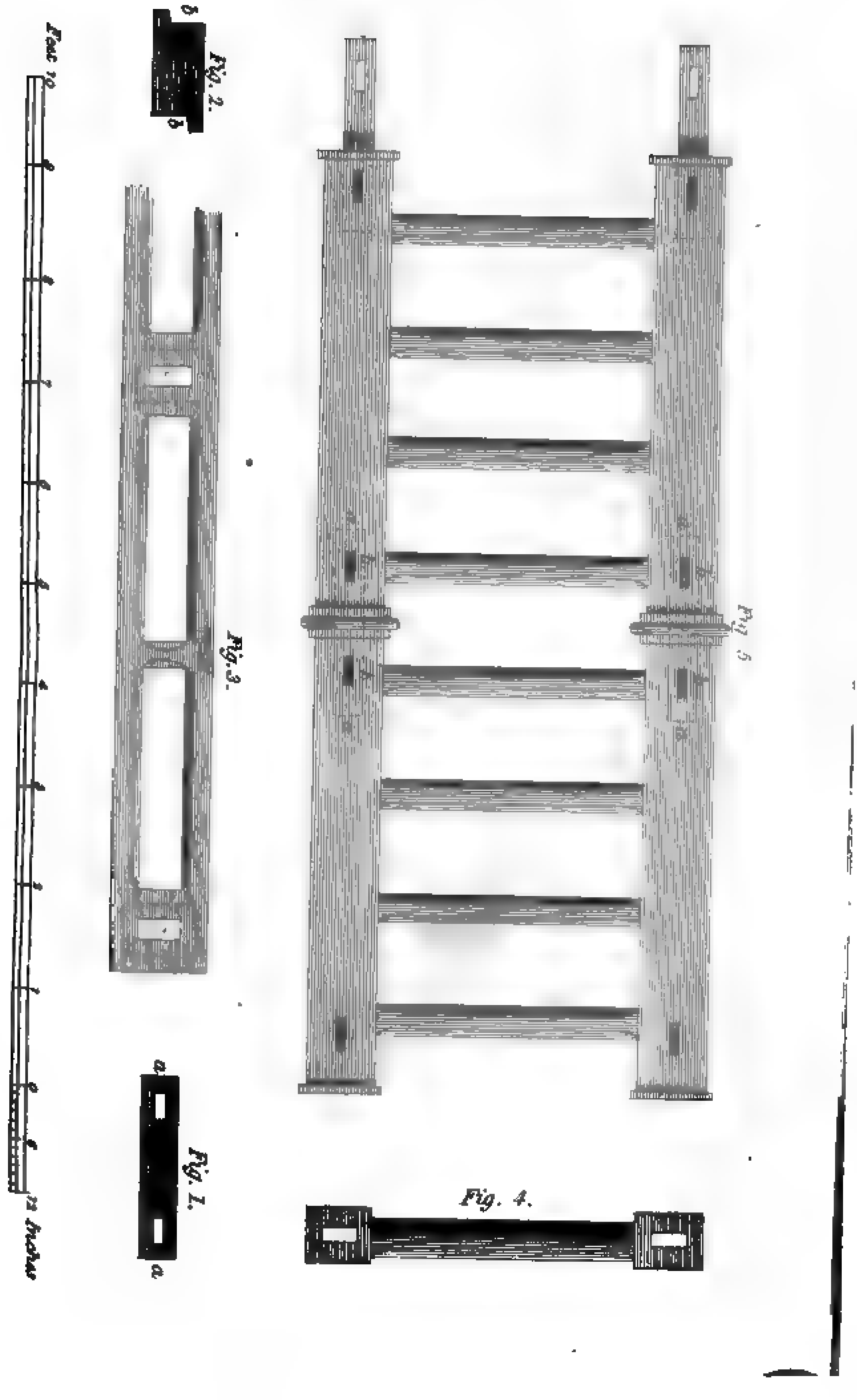

Feet 10
12 Inches
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5
a
b

Fig. 3. Fig. 1.

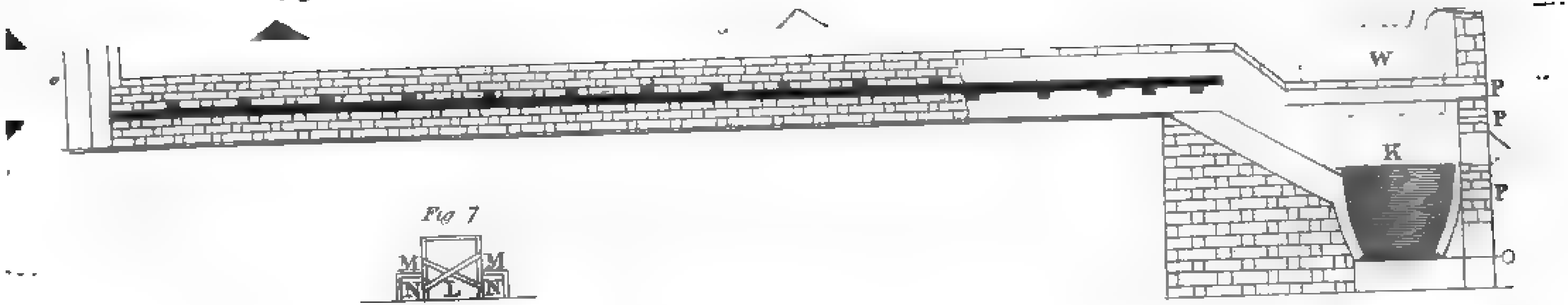
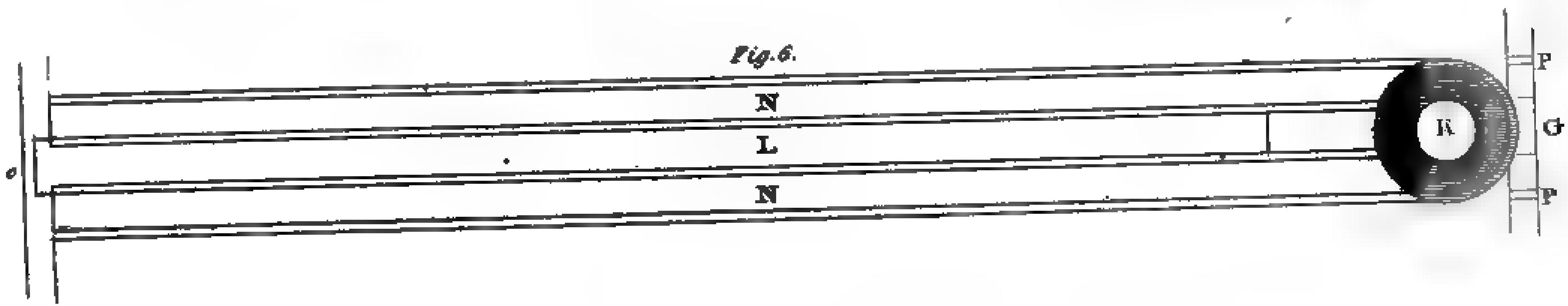


Fig. 6.



Specification of the Patent granted to EDWARD STEPHENS, *of the City of Dublin; for a Furnace, Stove, or Fire-Place, that can conveniently be applied to the burning of Lime-Stone; at the same Time that it is used for the heating of all Manner of Corn Kilns, Evaporating Stoves, and Drying Houses for Malt, Corn, Flax, Cloth, Starch, or any other Material that requires drying or heating; that it is applicable to the making of Coke from Coal, smelting of Metals, heating of Boilers, and other such like Purposes.* Dated January 29, 1803.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Edward Stephens do hereby declare, that the following is a particular description of the said furnace, stove, or fire-place, and of its various forms as applied to its different purposes.

First, the drawing (Fig. 1, Plate V.) shews a section of a circular furnace completely fitted up, on a scale of one-eighth of an inch to a foot *: it is there applied to a corn or malt kiln of twenty feet square, where A represents a metal pan, or furnace with the frame it rests on, which frame also supports the sliding bars at bottom, for the purpose of letting out the lime intended to be burned therein; into this pan is put the coal, turf, culm, or coke, or other fuel intended to be used either separately or with lime-stone, iron ore, or any other material that may require to be burned, roasted, or smelted, and that can with safety be ignited under a kiln of said description, as by this means a double operation is performed, and the expense of fuel considerably saved; B represents a canopy

* The figures in the plate are reduced one third.

 of

or cover of sheet iron which is placed over said pan, for the purpose of receiving the direct rays of the fire, and of increasing its power; C, the mouth-piece or furnace door, through which the fuel, stone, &c. is put into the pan; D is a brick arch, built at three inches distance from the sides and top of the canopy; this space of three inches is left open to admit a current of air into the body of the kiln, which air in its passage over the sheet iron gets much heated, and is thereby prepared to ascend in a strong current to the corn, malt, &c. that is spread above on the kiln floor, and well calculated to carry off its moisture with great rapidity, provided too much corn is not put on the kiln at once; the thickness recommended is about three inches of wheat, oats, or barley, and five inches of wet malt; E shews a section of the brick wall, that surrounds the metal pan as high as the upper flanch, but being also kept three inches distance, leaves a space or air chamber for letting into the kiln (by the small back aperture) another considerable portion of air that gets much heated in its passage round the pan, which is kept continually red-hot by the fuel and lime stone within; F is the spark plate, usually hung in open corn kilns for the purpose of spreading the heat more equally; but it is here used to break the current of hot air, which might otherwise entirely ascend through the centre of the kiln floor; G is the ash pit or space under the furnace where the lime falls, when the bars are drawn out for that purpose. Note, that this is to be done about every quarter of an hour, and fresh lime stone and fuel put in at the top of the pan, which ought to be constantly kept full, and as near the degree of uniform red heat as possible, as the better and stronger the fire is kept up, the greater quantity of heated air will pass into the kiln, and of course the greater effect will be produced.

Care should be taken to draw but one or two sliding bars at a time, lest too much lime should descend at once, and thereby occasion the fire to decline; the holes at the sides and over the furnace door shew where the air is admitted, between the canopy and the brick arch that surrounds it; and the three holes under the door serve for a passage for air to get to the front of the heated pan, and also for sight holes to notice when it is sufficiently red; H is the main passage that leads to the furnace door, this is built with brick or stone, and arched or covered over; I, the metal sleeper that the furnace rests on, which is represented in the drawing as framed, but it may be formed of three separate pieces of metal, provided room is left for the sliding fire bars to draw in and out. The same letters refer to the separate parts of said furnace, which are drawn (in Figs. 2) on a larger scale of one quarter of an inch to a foot*. The remaining parts of the kiln as drawn in the annexed plan differ so little from those in general use, for drying malt or corn, that it is unnecessary to describe them more fully, particularly as the invention here claimed is only for the furnace and air chamber, their appendages and general application. It is, however, proper to say, that every aperture in the walls or roof of the kiln must be closed, that might admit cold air either under or over the corn, except the opening round the furnace, and that through the louvre or steam-passage in the roof. Note, such tiles as are best calculated to pass the greatest current of air through them are to be preferred: those in most general use are twelve inches square and two inches thick, and have holes or perforations so tapered as to prevent their being stopped by dust or grain.

This furnace, when used for a stove or drying house, acts on the same principle as last described: namely, by

* Reduced in the plate one-third.

conveying through the article to be dried a strong current of pure atmospheric air, heated to the degree required to produce the effect. The application of the furnace must however differ materially, when cloth, linen, cotton, hops, or any other description of goods are to be dried, which might receive injury from the dust arising from the fire below; therefore, in this case, it will be necessary to confine the fire flue very closely, and yet to take up almost the entire heat before it can make its way out of the said flue, which likewise acts as a chimney. In this case, K (Fig. 5 which is the elevation, and Fig. 6 the ground-plan) represents the furnace set in the same manner as when applied to the corn kiln, except that it here delivers its flame and heat into the brick fire flue L, which is eighteen inches square, and runs on the floor of the drying house, it has only a direct communication with the furnace at one end, and with the upright chimney at the other; across said fire flue are inserted the square sheet iron or copper pipes M, (Fig. 7,) of three inch bore and sufficient length to reach nearly through both walls of said flue, these pipes are placed diagonally as represented in the plan, and have their lower ends inserted in the air flue N, that is nine inches square and runs along the side of the fire flue, but are quite distinct from it. These two air flues have a communication with the air chamber formed round the metal pan, which is supplied with the external air through the lateral passages P; now when this fire is lit, the sheet iron pipes in the fire flues get heated to a high degree, and of course they draw in a supply of air from the air flue, which their lower end communicates. This air which comes warm from the air chamber gets farther heated in its passages through the heated pipes, delivers itself into the drying house, and is immediately followed by a fresh current, which when once produced will continue as long as the fire in

the

the furnace is kept up; and after this air has seized the moisture of the article submitted to its action, they then pass off together through the louvre or steam pipes in the roof of the drying house.

It now remains for me to describe this fire-place as adapted to the heating, boiling, or evaporating any liquid, or to the heating of reverberating furnaces, ovens, &c. &c. in which case the direct flame may be first solely applied to their use, and having exerted its influence there, the remaining heat is afterwards taken up by the pipes placed diagonally in the fire flue or chimney as before described in the drying house, which chimney may either be upright or horizontal; for the more clearly understanding this application of the fire place, it is only necessary to refer to its situation in respect to the stove or drying house, where we find its full powers used to heat a number of pipes in a flue, from which can be easily understood that if a steam engine or other boiler, &c. a salt pan, or reverberating furnace or oven, was placed immediately over the fire place, or between it and the pipes W, that not only the desired effect would be produced, but the treble advantage obtained of burning lime, boiling water, &c. and heating a drying house of the greatest extent with a regular current of pure atmospheric air, raised to such a temperature as would best suit the article to be dried. Or should this furnace be required only to burn lime, and heat or boil any liquid, then it may be built of brick or any other material that stands the fire, and applied to the pan or boiler as represented in Fig. 8. In this situation I use one of them for heating a steam engine boiler, which it does effectually with about half the fuel used in my former fire place.

Lastly, my said invention consists not only in the construction of the furnace, but in the method of procuring

curing a strong current of heated air, and taking up nearly the entire result of the fuel before it can escape out of the chimney top, and also in the application of an air chamber which acts without a valve, register, or damper, and a fire place that requires but little or no expense to keep it constantly at work, being adapted to the effectual burning of lime and cheap fuel, which when burned can be occasionally drawn out, without stopping the process or injuring the ignited fuel remaining in the fire place, and that these furnaces or fire places can be made of various materials, and of different shapes and sizes according to the situation in which they are to be placed. The pipes in the fire-flue may be made of any material that readily transmits heat, and that they are applicable to all kind of kilns, drying houses, and boilers at present in use, as well as those that may hereafter be erected; when used in malt or corn kilns, a simple louvre or aperture at the top is sufficient to carry off the steam, therefore there is no necessity for a cow or moveable steam passage in the roof, as such an apparatus is no more required on a well constructed kiln than on a dwelling house chimney, that already freely permits the smoke to pass from the fire. This advantage, although considerable, is inferior to that of its preserving the health of the workmen, and the colour and quality of the grain which were generally much injured by the old kiln where air was imperfectly applied, and coal containing sulphur and other volatile substances too often used without any material being burned along with them that might correct their injurious tendency. Now this inconvenience will be hereafter done away, as it is well known that lime stone has the desired effect. This furnace adapted to a stove or drying house is so universally applicable, that there is scarcely a manufacture that may not receive considerable benefit by it, but particularly the

the woollen, linen, &c. &c. also the cotton printing trade; its use to the hop planters will appear evident, as hops are an article that require to be dried without injury to colour or flavour; it can also be easily applied to forcing or blow houses in gardens, and to the wards of hospitals where a regular supply of pure dry air is of so much consequence. Its use in saving fuel will be allowed on examining the top of the drying house chimney, even when coal is solely used, and comparing the small proportion of heat passing from it into the atmosphere, with the great proportion that goes from most chimneys in large manufactories; but when lime-stone can be procured the saving is still greater, as this article costs but a trifle at first, yet when burned is of considerable value, and in such universal use as to be absolutely necessary to many manufactories; but when lime stone cannot be had or burned to advantage, then turf, coal, wood, &c. may be effectually used, as these furnaces are adapted to the burning of all kind of fuel in general use, and by the means herein described, the principle objection to the erection of steam engines will be in a great measure removed, as the difficulty of procuring coal (particularly near large cities) has been the great obstacle in the way of this admirable piece of machinery getting into more general use. In witness whereof, &c.

References to Plate V.

Fig. 3, elevation of a malt or corn kiln. Fig. 4, ground plan; *a*, the coal-house; *b*, the lime-house. Fig. 5, *a*, *b*, lime and coal house; *c*, chimney. Fig. 7, cross section of fire and air flues, with their square pipes, say $2\frac{1}{2}$ by 4 inches. Fig. 8, *a*, boiler; *b*, fire flues; *c*, chimney; *d*, damper; *e*, feeding-pipe; *f*, steam-pipe; *g*, lime-kiln; *h*, lime and coal house.

Specification

Specification of the Patent granted to RICHARD POTTINGER, *of the Parish of Ealing, in the County of Middlesex, Engineer; for an Engine and Apparatus whereby Persons riding in Carriages may on Occasions, and in Circumstances of imminent Danger, liberate themselves, and escape impending Mischief, by freeing the Horse or Horses instantly from the Carriage; and, in Case of two Wheel Carriages, by causing them to stand in the same horizontal Position as they were before the Horse or Horses were freed from them by the Carriages stopping in the Space of a few Yards, without any violent Concussion, or Danger of overturning the Person in the Carriage, who may sit the whole Time with perfect Ease and Safety.* Dated February 27, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Richard Pottinger do hereby declare that my said invention is described in manner following; that is to say: For a curricle, the splinter-bar to be made of the best seasoned ash, with an hollow sunk in the back of it to receive an iron shaft or spindle, of about half an inch diameter, in two lengths, to which must be fixed four iron hooks, one at the end of each shaft, to move in a circular position; also an iron lever, with two flanchs, one of which is fixed to each shaft by nuts and screws. That part of the engine which falls to the ground, in order to assist in supporting and stopping the carriage, may appropriately be called anchor; which may be part wood and part iron, or wholly of iron, and is fixed to the axletree by two couplings screwed to it, at about eighteen inches asunder, or nine inches from the centre of the axletree, projecting about

one

one inch from the axletree, with a small hole in it, sufficient to admit an iron pin, of about half an inch diameter; which pin passing through the two iron flanches attached to the anchor, as well as through the couplings, the anchor by that means moves from the centre of the small iron pin at the axletree, the lever resting on the anchor, as it may either be inclosed in a groove made to receive it on the upper side the said anchor, or the lever may be so constructed as to lay on each side of the anchor, and be supported by small bolts or rollers to rest on it. In either case, when the engine is raised up to as great a height as the carriage will admit of, it is fixed in that position by a spring bolt, from which there must be a small leather strap conveyed into the carriage. By a slight pull of the said strap, on the approach of danger, the anchor falls; and, together with the lever, stop and support the carriage. This movement of the lever turns the hooks, which are annexed to the iron shaft in the splinter-bar, and frees them from the shackles or rollers to which the traces are joined. The anchor may be provided with a roller, or two rollers, one of each side of it in the front end, that as it falls to the ground it will not stop the carriage too suddenly; or otherwise, if no roller is introduced, the front of the anchor which falls to the ground must be so formed as to prevent it stopping the carriage too suddenly. The horses being thus capable of being free from the carriage, excepting as to the connection with the pole, it becomes necessary that in the same instant they shall be free from the pole also; for which end there must be provided a leather or iron socket, to receive the end of the pole called the pole-piece, to which the straps must be fixed; and likewise a thin iron plate, to go from the said socket on the under side of the pole, to which the bar is fixed by other lea-

ther-work, for supporting the carriage. At that end of the plate must be a mortise, to admit the trigger; which trigger is acted upon by means of a small iron rod passing from it in a groove on the under side of the pole, and connected with the lever; the movement of which either fixes the horses to the pole, or occasions their being liberated at the moment the traces are freed from the splinter-bar. The whole of the iron-work to the pole must be inclosed by leather-work, neatly executed, and in such a manner as not to obstruct the movements of any part of the same. For a one-horse chaise or gig the principle and apparatus will be the same as the curricle, with the exception of the iron shaft, which may work in boxes in front of the bar, or at the back of it, as described to the curricle. For four-wheel carriages, the apparatus must be the same as the curricle, except the fixing of the anchor, which, in order for preventing in cases of danger, and when the horses are freed from the carriage, must be fixed to the hind axletree or perch, by which means the moment it falls to the ground steadies the carriage, and prevents its turning out of the road. It likewise, by means of the two iron flukes attached to the anchor, will insure the carriage to stop in a few yards. The stem of the anchor, or sundry apparatus appertaining thereto, must be of sufficient length when fixed up so as to reach the end of the lever, that the same motions as before described to the curricle shall liberate the whole at the same moment. The small iron rod as described to lay in a groove on the under side of the pole of a curricle, must for a four-wheel carriage be continued of sufficient length for the trigger to work, and fix in a mortise in the pole-piece.

In witness whereof, &c.

A Cheap

A Cheap and Expeditious Method of Draining Land.

By T. B. Bayley, Esq. F. R. S. and S. A.

With a Plate.

From Hunter's Georgical Essays.

FROM a very extensive experience, I recommend the following method of draining land, as effectual, durable, and cheap.

First, make the main drains down the slope or fall of the field. When the land is very wet, or has not much fall, there should, in general, be two of these to a statute acre; for the shorter the narrow drains are, the less liable they will be to accidents.

The width of the trench for the main drains should be, at the top, about thirty inches; but the width at the bottom must be regulated by the nature and size of the materials intended to be used. If the drain is to be made of bricks ten inches long, three inches thick, and four inches in breadth, then the bottom of the drain must be twelve inches; but if the common sale bricks are used, then the bottom must be proportionably contracted. In both cases there must be an interstice of one inch between the bottom brick and the sides of the trench, and the vacuity must be filled up with straw, rushes, or loose mould. For the purpose of making these drains, I order my bricks to be moulded ten inches long, four broad, and three thick. These dimensions make the best drain; and I beg leave to be understood, throughout this essay, as speaking of bricks formed in the above manner.

The method I pursue in constructing my main drains is as follows:

When the ground is soft and spungy, the bottom of the drain is laid with bricks, placed across. On these, on each side, two bricks are laid flat, one upon the other, forming a drain six inches high and four broad. This is covered with bricks laid flat. (Fig. 2. Plate VI.)

When I first engaged in this mode of draining, I conceived that in places where the bottoms of the main drains were firm and solid, as of clay or marl, it would be an unnecessary expense to pave them with brick. Under this idea, I recommended them to be constructed as in Fig. 3, the sides being formed by placing one brick edgewise, instead of two laid flat. But after the experience of some years, I found that the access of air and the alternation of wet and dry, occasioned the hardest clay, or marl, to tumble down, whereby the side bricks, not having a paved bottom, were made to fall in. From the experience of this circumstance, I now direct the main drains to be invariably paved with brick, as represented in Fig. 2. This will render them as lasting as the sod, or pipe drains, which I have found free and open after being constructed twenty years. When stones are used instead of bricks, the bottom of the drain should be about eight inches in width. And here it will be proper to remark, that, in all cases, the bottom of the main drains must be sunk, four inches below the level of the narrow ones, even at the point where the latter fall into them.

The main drains should be kept open till the narrow ones are begun from them, after which they may be finished: but before the earth is returned upon the stones, or bricks, it will be adviseable to throw in straw, rushes, or brush-wood, to increase the freedom of the drain.

The small narrow drains should be cut at the distance of sixteen or eighteen feet from each other, and should

fall

fall into the main drain at very acute angles, to prevent any stoppage. At the point where they fall into, and eight or ten inches above it, they should be made firm withbrick or stone.

In making the narrow drains I employ four labourers. The first man, with a common spade, takes out the turf, or sods, eighteen inches wide (the drains being before marked out), and lays them carefully on one side; the second man, with a common spade also, digs out two, three, or more spits of earth (laying it on the other side of the trench) till he has cut through the soil, or staple, and come to the under-stratum of clay, marl, or other hard and solid body of earth. The bottom and sides of this trench must be cleanly wrought; and, allowing for the sloping of the sides in working, should, at the bottom, be clear sixteen inches wide.

In this trench the frame, Fig. 5. is laid; and, in the middle of it, the third man, who ought to be the strongest and most expert, works the long narrow draining spade in the body of the clay. By taking care to work it at its full depth, he is always sure of his level, if the drains are properly laid out. The wooden frame is of great use; it gives a firm support to the feet of the workman, keeps the bottom of the trench smooth and clean, and serves as a purchase to the wings of the narrow tool. Fig. 6, 7, 8, 9, 10.

When thirty or forty yards have been cut out by the draining spade, the fourth man cleans the bottom of the drain with the scoop, Fig. 11. and works it quite smooth; he then covers it with the sods, laying the grass side downwards. In this part of the work, too much care and attention cannot be used. The sods should be sound and dry, cut even on the sides, and fitted closely to each other. No broken or rotten pieces should be put in;

and

and if any of the sods taken out, in cutting the trench for the narrow drains, are bad, good ones, firm and full of roots of rushes, strong grass, &c. should be got in the other parts of the field, and their place supplied with the decayed ones. In marshy bad fields, where *sound* turf cannot be had, little sticks may be placed across the trench, and the loose and tender sods safely laid upon them. The narrow drains being thus covered, the earth must be thrown in again, taking care that the clay, &c. brought out by the narrow tool, be not mixed with it. No greater length of these drains should be cut than can be finished the same day. The price varies with the depth. For the main drains cut thirty inches above, and thirty-eight deep, laid with bricks, covered, &c. I give about ninepence *per* rod (eight yards). For the narrow drains, constructed and completely finished according to the foregoing directions, their whole depth (including that of the trench, and that of the draining spade) being thirty-two or thirty-four inches, I give fivepence halfpenny *per* rod (eight yards *.)

From my much-respected friend, the Rev. Mr. Whately, of Nonsuch-Park, in Surry †, I first received an account of the Hertfordshire and Essex method of draining; at the same time he obligingly sent me a set of the tools made use of there, with very particular directions.

The great price of stone and brick in my neighbourhood rendered the Hertfordshire method too expensive. Hence I took the idea of the sod drains, and the improve-

* At this price my labourers, after they were a little acquainted with the work, earned, even in winter, two shillings a day each.

† Professor of Rhetoric in Gresham College.

ment

ment of the tools. Mr. Young, in the second edition of his justly-esteemed "Six Months' Northern Tour," calls me the inventor of this method of draining. All the merit I claim, is that of having introduced, together with an amendment of their construction, the application of these celebrated tools to a mode of draining with sods or turf, where stone, brick, or even brushwood, is extremely scarce and dear.

Wherever this is the case, I can, from my own experience, recommend the hollow drains covered in the above manner.

I must observe that, in loose crumbly soils, where the wetness does not arise from the retention of water by an under-stratum of clay, but from springs, these drains are *improper*; for such lands they should be made of brick or stone. On the contrary, which is most commonly the case, when the wet is prevented from passing off by an under-stratum of clay, marl, or a mixture of both, these sod drains are excellent.

For if the whole staple or soil is cut through as it ought to be, the narrow tool will be wholly worked in a solid body, and leave a firm compact ledge, or shoulder, of six inches wide on each side, for the sod to rest on, see Fig. 4. The strength with which the sods are supported, and their depth in the ground, will effectually prevent their removal by any weight on the surface, and secure them from all effects of the weather. Being, at their least depth, twelve inches below the surface, they will also be beyond the reach of the plough.

With respect to the shape of the narrow drains, it will be scarce necessary to observe, that their great depth, and contracted width, enable them to draw in the moisture of the earth, and at the same time to keep themselves clear and open.

The

The tools should be formed of well-wrought iron, and made with great care and exactness. Including the shaft, the narrow tool should weigh 12 lb. *

References to Plate VI.

Fig. 1, a field with the drains properly laid out. A, A, A, the main drains; *a, a, a, a,* the narrow sod drains. Fig. 2, a brick drain; proper whether the bottom be hard or soft. Fig. 3, a brick drain; formerly recommonded when the bottom was hard, as of clay or marl; but discontinued for reasons already given. Fig. 4, a narrow drain; *a, a,* the shoulders for the sod to rest upon; *b,* the cut made by the narrow spade. Fig. 5, the wooden frame to be laid in the trench. It is made of two oak-boards, (inch thick) each twelve feet long, and six inches in breadth. They are fastened together at the ends by two ribs on the upper side, leaving a slit of five inches for the entrance of the narrow spade. *a,* the handle. Fig. 6, a front view of the narrow draining spade. *a,* the shaft; *b,* the wings for the workman's foot; *c,* the iron part of the spade, which is gently concave. Fig. 7, a side view. *a,* the shaft; *b,* the wings; *c,* two sharp fins, one on each side, for cutting the next spade-graft; *d,* the iron part. Fig. 8, a back view. *a,* the shaft; *b,* the wings; *c,* the cutting fins; *d,* the iron part which is convex. Fig. 9, a back view in perspective. *a,* the shaft; *b,* the wings; *c,* the fins; *d,* the iron part. Fig. 10, a front view in perspective. *a,* the shaft; *b,* the wings; *c,* the fins; *d,* the iron part. Fig. 11, the scoop. *a, a,* the wooden handle; *b,* the iron scoop.

* These tools are made by Benjamin Royle, smith, in Dolefield, Danesgate, Manchester; and by William Staveley, smith, in Stonegate, York.—Price 12s.

Account

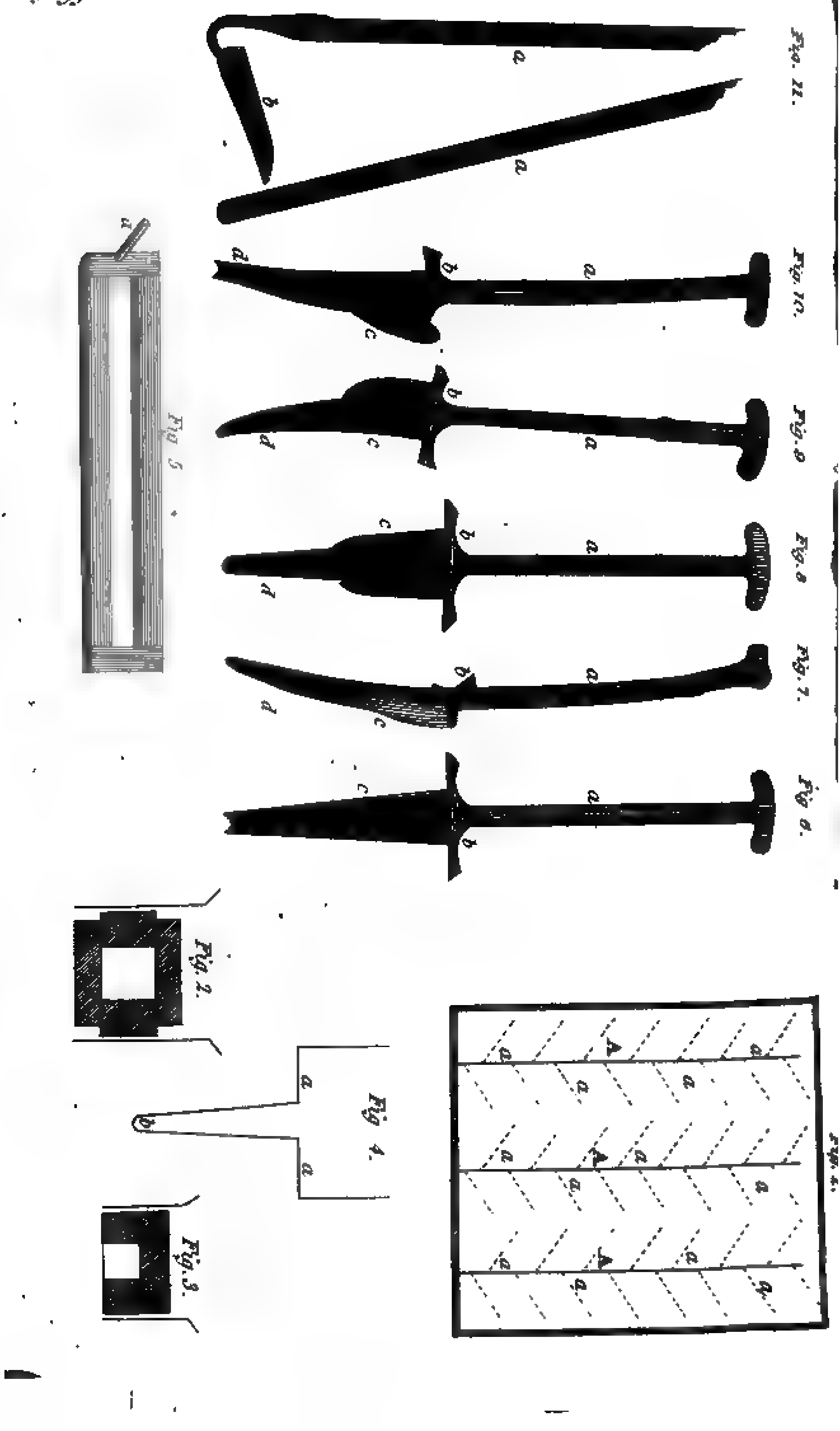


Fig. 11.
Fig. 10.
Fig. 9.
Fig. 8.
Fig. 7.
Fig. 6.
Fig. 5
Fig. 2.
Fig. 4.
Fig. 3.

Account of some Experiments and Observations on the constituent Parts of certain astringent Vegetables, and on their Operations in Tanning.

By HUMPHRY DAVY, *Esq.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

THE discovery made by M. Seguin, of a peculiar vegetable matter which is essential to the tanning of skin, and which is possessed of the property of precipitating gelatine from its solutions, has added considerably to our knowledge of the constituent parts of astringent vegetables.

M. Proust has investigated many of the properties of this substance; but, though his labours, and those of other chemists, have led to various interesting observations, yet they are far from having exhausted the subject. The affinities of tanning have been hitherto very little examined; and the manner in which its action upon animal matters is modified by combination with other substances, has been scarcely at all studied.

At the desire of the Managers of the Royal Institution, I began, in September, 1801, a series of experiments on the substances employed in the process of tanning, and on the chemical agencies concerned in it. These experiments have occupied, ever since, a considerable portion of my leisure hours; and I now presume to lay before the Royal Society an account of their general results. My chief design was, to attempt to elucidate the practical part of the art; but, in pursuing it, I was necessarily led to general chemical inquiries concerning the analysis of the different vegetable substances containing tannin, and their peculiar properties.

I. *Observations on the Analysis of astringent Vegetable Infusions.*

The substances that have been supposed to exist most generally in astringent infusions are, tannin, gallic acid, extractive matter.

The presence of tannin in an infusion, is denoted by the precipitate it forms with the solution of glue, or of isinglass. And, when this principle is wholly separated, if the remaining liquor gives a dark colour with the oxygenated salts of iron, and an immediate precipitate with the solutions of alum and of muriate of tin, it is believed to contain gallic acid, and extractive matter.

The experiments of Messrs. Fourcroy, Vauquelin, and Seguin, have shown that many astringent solutions undergo a change by exposure to the atmosphere; an insoluble matter being precipitated from them. A precipitation is likewise occasioned in them by the action of heat; and these circumstances render it extremely difficult to ascertain, with any degree of precision, the qualities of their constituent parts, as they exist in the primitive combination.

After trying several experiments on different methods of ascertaining the quantity of tannin in astringent infusions, I was induced to employ the common process of precipitation by gelatine, as being the most accurate.

This process, however, requires many precautions. The tanning principle in different vegetables, as will be seen hereafter, demands for its saturation different proportions of gelatine; and the quantity of the precipitate obtained by filtration is not always exactly proportional to the qualities of tannin and gelatine in solutions, but is influenced by the degree of their concentration. Thus, I found that 10 grains of dry isinglass, dissolved in two ounces of distilled

distilled water, gave, with solution of galls in excess, a precipitate weighing, when dry, 17 grains; whilst the same quantity, dissolved in six ounces of water, produced, all other circumstances being similar, not quite 15 grains. With more diluted solutions, the loss was still greater; and analogous effects took place, when equal portions of the same solution of isinglass were acted on by equal portions of the same infusion of galls diluted in different degrees with water; the least quantity of precipitate being always produced by the least concentrated liquor. In all cases, when the weak solutions were used, it was observed, that the residual fluid, though passed two or three times through the filtre, still remained more or less turbid and opaque; so that it is most likely that the deficiency arose from the continual suspension of some of the minutely divided solid matter in the liquid mass.

The solutions of gelatine, for the purposes of analysis, should be employed only when quite fresh, and in as high a state of saturation as is compatible with their perfect fluidity. I have observed, that in cases when they approach towards the state of jelly, their power of acting upon tannin is materially altered, and they produce only a very slight precipitation. As the degree of fluidity of solutions of gelatine is influenced by their temperature, I have found it expedient in all comparative experiments to bring them, and the astringent infusions on which they are designed to act, as nearly as possible to a common degree of heat. My standard temperature has been between 60 and 70° Fahrenheit; and the solutions of gelatine that I have used were made by dissolving 120 grains isinglass in 20 ounces of water.

In ascertaining the proportions of tannin in astringent infusions, great care must be taken to prevent the presence of any excess of gelatine; for, when this excess exists, I

have found that a small portion of the solid compound formed is redissolved, and the results of the experiment otherwise affected. It is not difficult to discover the precise point of saturation, if the solution of isinglass be added only in small quantities at a time, and if portions of the clear liquor be passed through a filtre at different periods of the process. The properties of these portions will indicate the quantities of the solution of gelatine required for the completion of the experiment.

That the composition of any precipitate containing tannin and gelatine may be known with a tolerable degree of precision, it is necessary that the isinglass employed in the solution, and the new compound formed, be brought as nearly as possible to the same degree of dryness. For this purpose, I have generally exposed them, for an equal time, upon the lower plate of a sand-bath, which was seldom heated to more than 150°. This method I have found much better than that of drying at the temperatures of the atmosphere, as the different states of the air, with regard to moisture, materially influence the results.

Mr. Hatchett has noticed, in his excellent Paper on Zoophytes, &c.* that isinglass is almost wholly composed of gelatine. I have found, that 100 grains of good and dry isinglass contain rather more than 98 grains of matter soluble in water. So that, when the quantity of isinglass, in any solution employed for acting upon an astringent infusion, is compared with the quantity of the precipitate obtained, the difference between them will indicate the proportion of tannin, as it exists in the combination.

After the tannin has been separated from an astringent infusion, for the purpose of ascertaining its other component parts, I have been accustomed to evaporate the re-

* Phil. Trans. for 1800, page 327.

sidual

sidual liquor very slowly, at a temperature below 200°.*. In this process, if it contains extractive matter, that substance is in part rendered insoluble, so as to fall to the bottom of the vessel. When the fluid is reduced to a thick consistence, I pour alcohol upon it. If any gallic acid or soluble extractive matter be present, they will be dissolved, after a little agitation, in the alcohol; whilst the mucilage, if any exist, will remain unaltered, and may be separated from the insoluble extract, by lixiviation with water.

I have made many experiments, with the hope of discovering a method by which the respective quantities of gallic acid and extractive matter, when they exist in solution in the alcohol, may be ascertained; but without obtaining success in the results. It is impossible to render the whole of any quantity of extractive matter insoluble by exposure to heat and air, without at the same time decomposing a portion of the gallic acid. That acid cannot be sublimed, without being in part destroyed; and, at the temperature of its sublimation, extractive matter is wholly converted into new products.

Ether dissolves gallic acid; but it has comparatively little action upon extractive matter. I have been able, in examining solutions of galls, to separate a portion of gallic acid by means of ether. But, when the extractive matter is in large quantities, this method does not succeed, as, in consequence of that affinity which is connected with

* M. Deyeux has shewn, (*Annales de Chimie*, Tome XVII. page 36,) that in the process of evaporating solutions of galls, no gallic acid is carried over by the water, at a temperature below that of ebullition. Many astringent infusions, however, lose a portion of their aromatic principle, even in cases when they are not made to boil; but this substance, through evident to the smell, in the water that comes over, cannot be detected by chemical reagents.

mass,

mass *, the greatest part of the acid continues to adhere to the extract.

Alumine has a strong attraction for extractive matter; but comparatively a weak one for gallic acid †. When carbonate of alumine is boiled for some time with a solution containing extractive matter, the extractive matter is wholly taken up by the earth, with which it forms an insoluble compound; but into this compound some of the gallic acid appears likewise to enter; and the portion remaining dissolved in the solution is always combined with alumine.

I have not, in any instance, been able to separate gallic acid and extractive matter perfectly from each other; but I have generally endeavoured to form some judgment concerning their relative proportions, by means of the action of the salts of alumine, and the oxygenated salts of iron. Muriate of alumine precipitates much of the extractive matter from solutions, without acting materially upon gallic acid; and, after this precipitation, some idea may be formed concerning the quantity of the gallic acid, by the colour it gives with the oxygenated sulphate of iron. In this process, however, great care must be taken not to add the solution of the sulphate of iron in excess; for, in this case, the black precipitate formed with the gallic acid will be redissolved, and a clear olive-coloured fluid only will be obtained.

The saline matters in astringent infusions adhere so strongly to the vegetable principles, that it is impossible to ascertain their nature with any degree of accuracy by means of common reagents. By incineration of the pro-

* See Berthollet, *Rechetches sur les Lois de l'Affinité. Mém. de l'Institut National.* Tome III. p. 5.

† See Fiedler, *Journal de Chimie, par* J. B. Van Mons, Tome I. pag. 85.

ducts

ducts obtained from the evaporation of astringent infusions, I have usually procured carbonate of lime and carbonate of potash.

In the different analyses, as will be seen from the results given in the following sections, I have attended chiefly to the proportions of the tanning principle, and of the principles precipitable by the salts of iron, as being most connected with practical applications.

With regard to the knowledge of the nature of the different substances, as they exist in the primitive astringent infusion, we can gain, by our artificial methods of examination, only very imperfect approximations. In acting upon them by reagents, we probably, in many cases, alter their nature; and very few of them only can be obtained in an uncombined state. The comparison, however, of the products of different experiments with each other, is always connected with some useful conclusions; and the accumulation of facts with regard to the subject must finally tend to elucidate this obscure but most interesting part of chemistry.

II. *Experiments on the Infusions of Galls.*

I have been very much assisted in my inquiries concerning the properties of the infusions of galls, by the able Memoir of M. Deyeux, on galls *.

The strongest infusion of galls that I could obtain, at 56° Fahrenheit, by repeatedly pouring distilled water upon the best Aleppo galls broken into small pieces, and suffering it to remain in contact with them till the saturation was complete, was of the specific gravity 1.068. Four hundred grains of it produced, by evaporation at a temperature below 200°, fifty-three grains of solid matter; which, as well as I could estimate, by the methods of

* *Annales de Chimie*, Tome XVII. pag. 1.

analysis

analysis that have been just described, consisted of about $\frac{9}{10}$ of tannin, or matter precipitable by gelatine, and $\frac{1}{10}$ of gallic acid, united to a minute portion of extractive matter.

100 grains of the solid matter obtained from the infusion left, after incineration, nearly 4½ grains of ashes; which were chiefly calcareous matter, mixed with a small portion of fixed alkali. The infusion strongly reddened paper tinged with litmus. It was semitransparent, and of a yellowish-brown colour. Its taste was highly astringent.

When sulphuric acid was poured into the infusion, a dense whitish precipitate was produced; and this effect was constant, whatever quantity of the acid was used. The residual liquor, when passed through the filtre, was found of a shade of colour deeper than before. It precipitated gelatine, and gave a dark colour with the oxygenated sulphate of iron.

The solid matter remaining on the filtre, slightly reddened vegetable blues; and, when dissolved in warm water, copiously precipitated the solutions of isinglass. M. Proust †, who first paid attention to its properties, supposes that it is a compound of the acid with tannin: but I suspect that it also contains gallic acid, and probably a small portion of extractive matter. This last substance, as is well known, is thrown down from its solutions by sulphuric acid; and I found, in distilling the precipitate from galls of sulphuric acid, at a heat above 212°, that a fluid came over, of a light yellow colour, which was rendered black by oxygenated sulphate of iron; but which was not altered by gelatine.

* The fact of the precipitation of solution of galls by acids, was noticed by M. Dize. See *Annales de Chimie*, Tome XXXV. p. 37.

Muriatic

Muriatic acid produced, in the infusion, effects analogous to those produced by sulphuric acid; and two compounds of the acid and the vegetable substances were formed: the one united to excess of acid, which remained in solution; the other containing a considerable quantity of tannin, which was precipitated in the solid form.

When concentrated nitric acid was made to act upon the infusion, it was rendered turbid; but the solid matter formed was immediately dissolved with effervescence, and the liquor then became clear, and of an orange colour. On examining it, it was found that both the tannin and the gallic acid were destroyed; for it gave no precipitate, either with gelatine or the salts of iron, even after the residual nitric acid was saturated by an alkali. By evaporation of a portion of the fluid, a soft substance was obtained of a yellowish-brown colour, and of a slightly sourish taste. It was soluble in water, and precipitated nitro-muriate of tin, and the nitrate of alumine; so that its properties approached to those of extractive matter; and it probably contained oxalic acid, as it rendered turbid a solution of muriate of lime.

When a very weak solution of nitric acid was mixed with the infusion, a permanent precipitate was formed; and the residual liquor, examined by the solution of gelatine, was found to contain tannin.

A solution of pure potash was poured into a portion of the infusion. At first, a faint turbid appearance was perceived; but, by agitation, the fluid became clear, and its colour changed from yellow brown to brown red; and this last tint was most vivid on the surface, where the solution was exposed to the atmosphere. The solution of isinglas did not act upon the infusion modified by the alkali, till an acid was added in excess, when a copious precipitation was occasioned.

 The

The compound of potash, and solution of galls, when evaporated, appeared in the form of an olive-coloured mass, which had a faint alkaline taste, and which slowly deliquesced when exposed to the air.

Soda acted upon the infusion in the same manner as potash; and a fluid was formed, of a red-brown colour, which gave no precipitate to gelatine.

Solution of ammonia produced the same colour as potash and soda, and formed so perfect an union with the tannin of the infusion, that it was not acted upon by gelatine. When the compound liquor was exposed to the heat of boiling water, a part of the ammonia flew off, and another part reacted upon the infusion, so as to effect a material change in its properties. A considerable quantity of insoluble matter was formed; and the remaining liquor contained little tannin and gallic acid, but a considerable portion of a substance that precipitated muriate of tin, and the salts of alumine.

When the experiment on the ebullition of the compound of the infusion and ammonia was made in close vessels, the liquor that came over was strongly impregnated with ammonia; its colour was light yellow, and, when saturated with an acid, it was very little altered by the salts of iron. The residual fluid, after the process had been continued for some time, as in the other case, precipitated gelatine slightly, but the salts of alumine copiously; and it gave a tinge of red to litmus paper.

When solutions of lime, of strontia, or of barytes, were poured in excess into a portion of the infusion, a copious olive-coloured precipitate was formed, and the solution became almost clear, and of a reddish tint. In this case, the tannin, the gallic acid, and the extractive matter, seemed to be almost wholly carried down in the precipitates; as the residual fluids, when saturated by an acid, gave no

precipitate

precipitate to gelatine, and only a very slight tint of purple to oxygenated sulphate of iron.

When the solutions of the alkaline earths were used only in small quantities, the infusion being in excess, a smaller quantity of precipitate was formed, and the residual liquor was of an olive-green colour; the tint being darkest in the experiment with the barytes, and lightest in that with the lime. This fluid, when examined, was found to hold in solution a compound of gallic acid and alkaline earth. It became turbid when acted on by a little sulphuric acid; and, after being filtrated, gave a black colour with the solutions of iron, but was not acted upon by gelatine.

When a large proportion of lime was heated for some time with the infusion, it combined with all its constituent principles, and gave, by washing, a fluid which had the taste of lime-water, and which held in solution only a very small quantity of vegetable matter. Its colour was pale yellow; and, when saturated with muriatic acid, it did not precipitate gelatine, and gave only a slight purple tinge to the solutions of the salts of iron. The lime, in combination with the solid matter of the infusion, was of a fawn colour. It became green at its surface, where it was exposed to the air; and, when washed with large quantities of water, it continued to give, even to the last portions, a pale yellow tinge.

Magnesia was boiled in one portion of the infusion for a few hours; and mixed in excess with another portion, which was suffered to remain cold. In both cases, a deep green fluid was obtained, which precipitated the salts of iron, but not the solutions of gelatine; and the magnesia had acquired a grayish-green tint. Water poured upon it became green, and acquired the properties of the fluid at first obtained. After long washing, the colour of the

magnesia changed to dirty yellow, and the last portions of water made to act upon it were pale yellow, and altered very little the solutions of iron.

When the magnesia was dissolved in muriatic acid, a brownish and turbid fluid was obtained, which precipitated gelatine and the oxygenated salts of iron. So that there is every reason to believe, that the earth, in acting on the astringent infusion, had formed two combinations; one containing chiefly gallic acid, which was easily soluble in water; the other containing chiefly tannin, which was very difficultly soluble.

Alumine boiled with the infusion became yellowish-gray, and gave a clear white fluid, which produced only a tinge of light purple in the solutions of iron. When the earth * was employed in very small quantity, however, it formed an insoluble compound only with the tannin and the extract; and the residual liquor was found to contain a gallate of alumine with excess of acid.

The oxides of tin and of zinc, obtained by nitric acid, were boiled with separate portions of the infusion for two hours. In both cases, a clear fluid, which appeared to be pure water, was obtained; and the oxides gained a tint of dull yellow. A part of each of them was dissolved in muriatic acid. The solution obtained was yellow: it copiously precipitated gelatine; and gave a dense black with the salts of iron. M. Proust †, who first observed the action of oxide of tin upon astringent infusions, supposes that portions of tannin and gallic acid are decomposed in the process, or converted, by the oxygen of the oxide, into new substances. These experiments do not, however, appear to confirm the supposition.

* Mr. Fiedler, I believe, first observed the action of alumine upon tannin. Van-Mons' Journal, Vol. I. page 86.

† *Annales de Chimie*, Tome XLII. p. 69.

M. Deyeux

M. Deyeux observed, that a copious precipitation was occasioned in infusion of galls, by solutions of the alkalis combined with carbonic acid. M. Proust has supposed that the solid matter formed is pure tannin, separated from its solution by the stronger affinity of the alkali for water; and he recommends the process, as a method of obtaining tannin.

In examining the precipitate obtained by carbonate of potash fully combined with carbonic acid, and used to saturation, I have not been able to recognise in it the properties which are usually ascribed to tannin; it is not possessed of the astringent taste; and it is but slightly soluble in cold water, or in alcohol. Its solution acts very little upon gelatine, till it is saturated with an acid; and it is not possessed of the property of tanning skin.

In various cases, in which the greatest care was taken to use no excess, either of the astringent infusion or of the alkaline solution, I have found the solid matter obtained possessed of analogous properties; and it has always given, by incineration, a considerable portion of carbonate of potash, and a small quantity of carbonate of lime.

The fluid remaining after the separation of the precipitate was of a dark-brown colour, and became green at the surface, when it was exposed to the air. It gave no precipitate to solution of gelatine; and afforded only an olive-coloured precipitate with the salts of iron.

When muriatic acid was poured into the clear fluid, a violent effervescence was produced; the fluid became turbid; a precipitate was deposited; and the residual liqour acted upon gelatine and the salts of iron, in a manner similar to the primitive infusion.

M. Deyeux, in distilling the precipitate from infusion of galls by carbonate of potash, obtained crystals of gallic acid. In following his process, I had similar results; and a fluid

a fluid came over, which reddened litmus-paper, and precipitated the salts of iron black, but did not act upon gelatine.

When the precipitate by carbonate of potash was acted upon by warm water, applied in large quantities, a considerable portion of it was dissolved; but a part remained, which could not in any way be made to enter into solution; and its properties were very different from those of entire precipitate. It was not at all affected by alcohol: it was acted on by muriatic acid, and partially dissolved; and the solution precipitated gelantine and the salts of iron. It afforded, by incineration, a considerable portion of lime, but no alkali.

In comparing these facts, it would seem, that the precipitate from infusion of galls consists partly of tannin and gallic acid united to a small quantity of alkali, and partly of these vegetable matters combined with calcareous earth; and it will appear probable, when the facts hereafter detailed are examined, that both the potash and the lime are contained in these compounds in a state of union with carbonic acid.

The solutions of carbonate of soda and of carbonate of ammonia, both precipated the infusion of galls in a manner similar to the carbonate of potash; and each of the precipitates, when acted on by boiling water, left a small quantity of insoluble matter, which seemed to consist chiefly of tannin and carbonate of lime.

The entire precipitate by carbonate of soda produced, when incinerated, carbonate of soda and carbonate of lime. The precipitate by carbonate of ammonia, when exposed to a heat sufficient to boil water, in a retort having a receiver attached to it, gave out carbonate of ammonia, (which was condensed in small crystals in the neck of the retort,) and a yellowish fluid, which had the

strong

strong smell and taste of this volatile salt. After the process of distillation, the solid matter remaining was found of a dark brown colour ; a part of it readily dissolved in cold water, and the solution acted on gelatine.

The residual fluid of the portions of the infusion which had been acted on by the carbonates of soda and of ammonia, as in the instance of the carbonate of potash, gave no precipitate with gelatine, till they were saturated with an acid ; so that, in all these cases, the changes are strictly analogous.

The infusion of galls, as appears from the analysis, contains in its primitive state calcareous matter. By the action of the mild alkalis, this substance is precipitated in union with a portion of the vegetable matter, in the form of an insoluble compound. The alkalis themselves, at the same time, enter into actual combination with the remaining tannin and gallic acid ; and a part of the compound formed is precipitated, whilst another part remains in solution.

When the artificial carbonates of lime, magnesia, and barytes, were separately boiled with portions of the infusion of galls for some hours, they combined with the tannin contained in it, so as to form with it insoluble compounds ; and, in each case, a deep green fluid was obtained, which gave no precipitate to gelatine, even when an acid was added, but which produced a deep black colour in the solutions of the salts of iron.

Sulphate of lime, when finely divided, whether natural or artificial, after having been long heated with a small quantity of the infusion, was found to have combined with the tannin of it, and to have gained a faint tinge of light brown. The liquid became of a blue-green colour, and acted upon the salts of iron, but not upon gelatine ; and there is every reason to suppose, that it held in solution a triple compound of gallic acid, sulphuric acid, and lime.

We

We owe to M. Proust the discovery that different solutions of the neutral salts precipitate the infusion of galls; and he supposes, that the precipitation is owing to their combining with a portion of the water which held the vegetable matter in solution. In examining the solid matters thrown down from the infusion, by sulphate of alumine, nitrate of potash, acetite of potash, muriate of soda, and muriate of barytes, I found them soluble, to a certain extent, in water, and possessed of the power of acting upon gelatine. From the products given by their incineration, and by their distillation, I am however inclined to believe that they contain, besides tannin, a portion of gallic acid and extractive matter, and a quantity of the salt employed in the primitive solution.

It is well known, that many of the metallic solutions occasion dense precipitates in the infusion of galls; and it has been generally supposed that these precipitates are composed of tannin and extractive matter, or of those two substances and gallic acid, united to the metallic oxide; but, from the observation of different processes of this kind, in which the salts of iron and of tin were employed, I am inclined to believe, that they contain also a portion of the acid of the saline compound.

When the muriate of tin was made to act upon a portion of the infusion, till no more precipitation could be produced in it, the fluid that passed through the filtre still acted upon gelatine, and seemed to contain no excess of acid; for it gave a precipitate to carbonate of potash, without producing effervescence. The solid compound, when decomposed by sulphureted hydrogen, after the manner recommended by M. Proust, was found strongly to redden litmus-paper, and it copiously precipitated nitrate of silver; whereas, the primitive infusion only rendered it slightly turbid; so that there is every reason to believe, that the pricipitate contained muriatic acid.

By

By passing the black and turbid fluid, procured by the action of solution of oxygenated sulphate of iron in excess upon a portion of the infusion, through finely-divided pure flint, contained in four folds of filtrating paper, I obtained a light olive-green fluid, in which there was no excess of sulphuric acid, and which I am inclined to suppose was a solution of the compound of gallic acid and sulphate of iron, with superabundance of metallic salt. I have already mentioned that gallic acid, when in very small proportion, does not precipitate the oxygenated salts of iron; and M. Proust, in his ingenious Paper upon the Difference of the Salts of Iron, has supposed that, in the formation of ink, a portion of the oxide of iron in union with gallic acid is dissolved by the sulphuric acid of the sulphate. This comes near to the opinion that they form a triple compound: and, in reasoning upon the general phenomena, it seems fair to conclude, that, in the case of the precipitation of tannin by the salts of tin and of iron, compounds are formed, of tannin and the salts; and that, of these compounds such as contain tin are slightly soluble in water, whilst those that contain iron are almost wholly insoluble.

In examining the action of animal substances upon the infusion of galls, with the view of ascertaining the composition of the compounds of gelatine, and of skin, with tannin, I found that a saturated solution of gelatine, which contained the soluble matter of 50 grains of dry isinglass, produced from the infusion a precipitate that weighed nearly 91 grains; and, in another instance, a solution containing 30 grains of isinglass, gave about 56 grains; so that, taking the mean of the two experiments, and allowing for the small quantity of insoluble matter in isinglass, we may conclude, that 100 grains of the compound of gelatine and tannin, formed by precipitation from saturated

solutions, contain about 54 grains of gelatine, and 46 of tannin.

A piece of dry calf-skin, perfectly free from extraneous matter, that weighed 180 grains, after being prepared for tanning by long immersion in water, was tanned in a portion of the infusion, being exposed to it for three weeks. When dry, the leather weighed 295 grains; so that, considering this experiment as accurate, leather quickly tanned by means of an infusion of galls consists of about 61 grains of skin, and 39 of vegetable matter, in 100 grains.

After depriving a portion of the infusion of all its tanning matter, by repeatedly exposing it to the action of pieces of skin, I found that it gave a much slighter colour to oxygenated sulphate of iron, than an equal portion of a similar infusion which had been immediately precipitated by solution of isinglass; but I am inclined to attribute this effect, not to any absorption of gallic acid by the skin, but rather to the decomposition of it by the long continued action of the atmosphere; for much insoluble matter had been precipitated, during the process of tanning, and the residuum contained a small portion of acetous acid.

In ascertaining the quantity of tannin in galls, I found that 500 grains of good Aleppo galls gave, by lixiviation with pure water till their soluble parts were taken up, and subsequent slow evaporation, 185 grains of solid matter. And this matter, examined by analysis, appeared to consist,

Of tannin	130 grains.
Of mucilage, and matter rendered insoluble by evaporation	12
Of gallic acid, with a little extractive matter	31
Remainder, calcareous earth and saline matter	12

The

The fluid obtained by the last lixiviation of galls, as M. Deyeux observed, is pale green; and I am inclined to believe, that it is chiefly a weak solution of gallate of lime. The ashes of galls, deprived of soluble matter, furnish a very considerable quantity of calcareous earth. And the property which M. Deyeux discovered in the liquor of the last lixiviations, of becoming red by the action of acids, and of regaining the green colour by means of alkalis, I have observed, more or less, in all the soluble compounds containing gallic acid and the alkaline earth.

TO BE CONCLUDED IN OUR NEXT.

On the Preparation of the Bulbs of the Hyacinthus non Scriptus, or common Blue-Bell, as a Substitute for Gum Arabic.

By Mr. THOMAS WILLIS, *of Lime-street, London.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. Willis *for this Communication.*

IN the year 1794, whilst collecting plants in a wood for botanical specimens, I observed that the root of the Hyacinthus non scriptus, the plant commonly called Blue-Bells, or Hare-Bells, was extremely mucilaginous; and on tasting it, I discovered only a very slight pungency. I collected a pound of the Bulbs, and, after slicing and drying them before a fire, they yielded about four ounces of powder. I thought that by keeping the powder some

 time,

time, the little acridness might go off, as it does in the arum-root powder. I tasted it about six months after, and found it perfectly insipid. I concluded it might be rendered useful for food or nourishment, but at that time pursued the matter no farther.

In the spring of 1800, gum-arabic having been a long time very dear, and likely to continue so, I thought this mucilaginous root might answer some of its purposes, for external use. I therefore procured seven pounds and a half of the Bulbs, which, when sliced and dried, produced two pounds of powder. Being soon afterwards in company with Mr. Charles Taylor, Secretary to the Society of Arts, &c. I mentioned to him that I had discovered a root which grew in great plenty in this kingdom, yielded a very strong mucilage, and which I imagined would answer the purposes of gum-arabic, in some of the manufactories. He said, if I pleased, he would send some of it down to Manchester, to be tried by the calico-printers.

Three or four ounces of the powder were given him, and sent down there: he was informed, upon trial, that it answered the purposes of fixing the calico-printers colours, equally as well as gum-arabic; and in the same proportion, of an ounce and a half of the powder, to four ounces of the mordant. Mr. Taylor received the samples of the printed cottons on which it had been used.

On the 15th of January, 1801, I furnished Mr. Taylor with eight ounces more of the powder; but have not since heard the result.

As this root can be easily procured, and used at a less price than gum-arabic has been sold for several years past, I think it may be rendered of great utility; and the Society

ciety of Arts, &c. by patronizing it, may be the means of making it a public benefit.

Care should be taken, and advice given, that the woods should not be left destitute of the roots; and it would be adviseable to offer premiums for cultivating the roots and offsets, as they are very increasing. By such means a constant supply may be had, if the roots answer the intended purposes.

I do not presume to offer any thing respecting the mode in which the Society may think proper to divulge the discovery, and promote the use of these roots; but I imagine, that if the roots are bruised and used fresh, they would answer the purpose better than when dried and powdered; and as it is now a proper time of the year for taking them up, and will continue to be so for two months, I wish that the discovery may be made known as soon as possible.

I have sent you specimens both of the dried roots and powder, that they may be seen at the Society's rooms, by the calico-printers. What I have done have been scorched a little in drying; but the colour would be much better, if proper care was taken in drying them.

From the trials made before the Committee with this Powder, with hot and cold water, from samples of the printed cotton produced which had been printed with it instead of Gum Senegal, and from experiments made in Manchester, it appears that the Hyacinthus non scriptus may, in many cases, be found a useful substitute for Gum-Arabic.

Extract

Extract from the Report on the Discovery of bituminous Wood; read to the Ligurian National Institute. By M. Mojon, *Public Professor of Chemistry, and Member of the Institute.*

From the Annales de Chimie.

In a plain about half a league from the mouth of the Magra, in the district of Castel Nuovo, on the confines of the Italian Republic, a vast quantity of bituminous wood has lately been discovered. It is situated in a soil formed of argillaceous and calcareous strata of greater or less depth, and very irregular through their whole extent. The nature of the fossil as well as the disposition of the soil, unquestionably prove that these strata must have been formed by some great convulsion which destroyed and overwhelmed whole forests.

This bituminous wood which in some places is scarcely covered by the soil still preserves its original form. In the researches that have been made trunks of different thickness, up to six decimetres, have been extracted; the transverse section of some is of an elliptic form, as if produced by pressure.

The colour of the fossil is in some instances a perfect black, in others a greyish black, and in others again, a wood-like brown. The black is sometimes extremely shining, having even the brilliancy of glass; the other two kinds are naturally dull, but are capable of being very highly polished.

Its texture is completely that of wood, having undergone no alteration from the bitumen which has penetrated it, so that it may frequently be decided to what trees such or such pieces have belonged.

This

This wood is not so brittle as coal, and if sawed perpendicularly to the axis of the trunks it presents a solid, compact, and very smooth surface. It takes fire readily, without the aid of other combustibles, and gives a bright clear flame whilst burning. The heat it produces is more powerful and steady than that of any other vegetable charcoal, and when once lighted it never goes out till entirely consumed, and leaves but a small quantity of ashes. The combustion may be interrupted and resumed at pleasure.

It weighs less than coal, its specific gravity being to that of distilled water as 1235 to 1000: those pieces which have the appearance of oak are even lighter.

In this fossil is sometimes found sulphureted iron distributed in larger and smaller particles, which, when long exposed to the air, are decomposed, and destroy the pieces on which they happen to be.

In other respects it possesses all the properties of coal; but if naturalists have long been in doubt respecting the origin of coal, on account of the variety of its texture, the irregularity of its form, its fragility, its strata resembling schistous stones, &c. the fossil of Castel Nuovo throws no difficulties in the way of their researches. The uniformity of the texture, the invariable direction of its fibres, the bark of the different trunks, the knots, the colour of the various species, the facility with which it takes fire, the alkali contained in its ashes; all these strongly-marked characters render it perfectly similar to artificial charcoal of wood. It should likewise be added, that it possesses this singular property, that it is capable of being employed for turnery work with the greatest facility, and that it thereby acquires a polish and brightness which render it far superior to ebony. It is, finally, a conductor of the electric fluid, and readily transmits it.

After

After this brief account of the locality and nature of the fossil, it may not be improper to mention some of the experiments made by the author to ascertain the purposes for which this substance might be advantageously employed.

He burned four hectogrammes of this bituminous wood in a fire-place, fixing a thermometer at the distance of two decimetres at a temperature of 10 degrees (Reaumur); in 16 minutes the wood was completely on fire; it gave a bright clear flame, less smoke than coal, and a slight smell of bitumen, which was not sulphureous, nor did it in the least incommode those who were nearest to it. The thermometer rose to 42 degrees, and eight hectogrammes of water that were set over the fire in a copper vessel began to boil. The thermometer remained at the same point twelve minutes, and the water continued boiling twenty minutes. When the ebullition had ceased, the thermometer fell to 26 degrees, and the water was reduced to one hectogramme. The fossil was entirely consumed in an hour and a quarter, leaving 15 grammes, of a reddish yellow, impalpable powder in the form of flakes.

He afterwards repeated the experiment, under the same circumstances, with oak-charcoal. The latter was ignited in twelve minutes, and in four more the eight hectogrammes of water in the copper vessel began to boil; the thermometer rose to 38 degrees, where it remained for eighteen minutes, and when the ebullition ceased it fell to 25. Almost all the water was evaporated, and the charcoal, which was consumed in the space of an hour and a half, left only one decagramme of ashes.

By this experiment, calculating the sum total of the heat respectively produced by the two substances during combustion, the author remarked that the bituminous wood

wood produced 816 degrees of heat on the thermometer in an hour and a quarter, whilst oak-charcoal raised only 784 in an hour and a half.

He likewise tried whether this fossil might be employed with advantage in the forge for iron. He made the two extremities of an iron rod red-hot for some time, one in bituminous wood, and the other in an equal quantity of oak-charcoal. When he took the rod from the fire he found the two extremities equally ductile, malleable, and tenacious. In all probability this new combustible might even be employed in reducing iron ore, but this the author had not an opportunity of ascertaining.

M. Mojon's report concludes with the following analysis:

This fossil wood yields almost the same product as coal, excepting the ashes, which contain a small quantity of potash.

By distillation are obtained phlegm, a yellowish bituminous oil, a quantity of carbonic acid gas, carbureted hydrogen gas, and at last an empyreumatic oil, much thicker than the former.

In alkohol a portion of this wood, after some time, yielded a blackish resinous substance.

By ebullition in distilled water calcareous earth and argile are precipitated.

If nitric acid be poured on this fossil, it is decomposed, and nitric gas is disengaged from it.

Finally, the 15 grammes of ashes, obtained by the above-mentioned combustion of 4 hectogrammes of this fossil, gave by lixiviation and filtration 5 decigrammes of potash, oxyd of iron, alumine, lime, and magnesia.

Essay on the Fecula of Green Plants.

(Concluded from Page 78.)

PARMENTIER was the first I believe who doubted that the tincture of feculæ in alkohol was resinous, because it was not precipitated by water. Yet, if we consider that water cannot separate it from gluten, that alkohol, oils, and greasy matters only possess that property; finally, that this substance when separated by alkohol and concentrated, is a fat tenacious body, insoluble in water, we must acknowledge, that there is no vegetable product which it resembles so nearly as resin; but we are about to shew that to render this character more decisive it is only necessary to add a little oxygen.

Oxygenated muriatic acid in a few days bleaches and hardens green resin, which then becomes ropy, like turpentine, and its tincture is diffusible in water; so that if the green portion of the feculæ belonged to those coloured juices which exist in the ingredients composing the tincture, the addition of oxygen would not convert it into a resin. But now that observation has taught us not to establish such rigorous limits as formerly to vegetable products, since we so frequently see them connected by intermediate qualities, we are not much surprised to see that a resin, elevated to the maximum of its divisibility, is capable of combining with water. Do not we see camphor, essential and vegetable oils, &c. completely dissolve in water? Yet we should not think of excluding similar products from the classification which their analysis has assigned them.

In oxygenated muriatic acid, green feculæ assume the colour of withered leaves, the winter livery of vegetable nature, and their tincture renders water extremely turbid.

bid. It is therefore but reasonable, to conclude, that though the colouring part of feculæ is incapable of resisting water when transmitted to it by alkohol, yet all its other qualities proclaim it an absolutely resinous substance; and notwithstanding this product, one of the most curious of the vegetable kingdom, which it embellishes by the variety of its tints, has been omitted, in the *system of chemical knowledge*, yet Rouelle, Daniel, Sage, Parmentier, and other chemists, have thought it worthy of investigation.

This resin dissolved in potash, leaves it to attach itself to silk, and tinges it a bright green, but too fading to be of utility; it is however capable of resisting verjuice, but its attraction for gluten in preference to vegetable fibre is conformable to established principles; for, in general, colouring bodies attach themselves to animalised substances rather than to the fibres of flax, hemp, and cotton. There must therefore be in fecula a substance analogous to wool, silk, &c.; and this is gluten.

V. Let us now examine the fecula by tests more capable of developing new characters of animalisation.

If fecula that has been boiled, or in a crude state, be immersed in water in summer, it begins to smell disagreeably in twenty-four hours; it soon exhales a stench like that of excrement, to which probably a person could not long expose himself without danger. The infectious miasma which issues from it instantly discolours metallic writings, and its liquor resembling purulent matter as quickly tarnishes silver.

To the corruption of this principle rather than to any other cause, are doubtless owing the pernicious exhalations from hemp and flax whilst steeping. Running water, equally proper for steeping them with standing water, quickly carrying off their extractive juices, nothing

capable of being destroyed by steeping can remain, excepting the fecula which connects the green fibres.

The liquor in which putrefied fecula has been immersed for a year contains sulphureted hydrogen, carbonate of ammonia, and gluten dissolved by means of the latter.

This liquor has the peculiar property of preserving its stercoral smell after long ebullition. The produce of it when distilled contains carbonate of ammonia combined with an infectious principle, which does not blacken metallic solutions, and with the nature of which I am utterly unacquainted. Acids do not weaken it by precipitating the fecula and saturating the ammonia, which induces me to think that if the effluvia of a mass of putrefied animal matter are capable of serving as a vehicle to the phosphorus and sulphur which it contains, that it is not those combustible matters alone which produce the infection. How very different, for instance, is the smell of putrefied fish or flesh, corrupted fecula or rotten cheese, from that of phosphureted and sulphureted hydrogen.

On Putrefaction.

But what is putrefaction? An alteration respecting which we have very few distinct ideas.

When fecula, curd, flesh, organised matters in general, have arrived at a certain period of this alteration, commonly called Putrefaction, they suddenly stop at a permanent state, where combinations unknown to us await them, as if to preserve, to embalm them, so as to insure their duration in this new state, and to protect them from all subsequent destruction.

When, for example, curd, fecula, gluten, or flesh, after having passed through the stages of putridity, and those alterations of colour and form by which they are disfigured, and have at length arrived the one at the cheesy state, the

the vegetable matters at that of mould, earth, powder, to which flesh however is not reduced after fifteen years of ichorous stagnation, they all stop at that point, without ever attaining, at least under our eyes, that final dissolution, which must terminate their existence, or reduce them to a mere earthy, inert matter, *non absimile cineribus*, to use the expression of Stahl, in short to a state in which no trace can any longer be perceived of the principles by which they were organised.

A putrefaction so complete never takes place. But we no sooner perceive an alteration in the organisation of a vegetable or animal matter, lividness, putridity, than we instantly imagine that it is beginning; and without being aware of it, we confound those appearances and those phenomena belonging to a kind of fermentation with which we are but little acquainted, and without reflecting whether its end accords with the ideas we have of it, whether it be actually the operation decreed by nature to analyse and resolve into the last elements those substances which are subjected to it.

Let us, therefore, conclude, that absolute putrefaction is a thing of which we are utterly ignorant. But to return to fecula, it is time to examine that kind which is sufficiently fine to pass through the filtre.

VII. Let us take, for instance, the filtered juice of the cabbage, one of those plants which yield it in the greatest quantity. And the better to observe, at the same time, the difference between this second fecula and albumen, we shall submit the latter to the same experiments. The white of an egg beat up in a pint of water will furnish the liquor necessary for the comparison.

1. Into water, heated to 50 degrees, plunge two matrasses, one with filtered juice and the other with albumen. The juice in an instant becomes turbid with cheesy

cheesy flakes which fall to the bottom. The albumen at the same temperature experiences not the least alteration.

2. On a furnace place two matrasses, one with juice diluted with 20 parts of water and the other with albumen. But the fecula, be it ever so much diluted, is completely separated from it by heat. This clearly proves its insolubility. On the other hand the water of albumen as it grows hot appears turbid, without ceasing to be transparent; it may be boiled and concentrated, and yet it deposits no flakes nor any substance like fecula. If evaporated in an open vessel, it leaves nothing but a varnish of white of egg. Darcet has already demonstrated that albumen diluted with a great proportion of water, cannot be again separated from it by heat. Albumen is a soluble mucilage, fecula is not, and the temperature which coagulates the former, makes no alteration in the state of the latter.

3. The water of albumen keeps several days without alteration; the juice of plants, on the contrary, is continually changing, which interrupts its transparency. If you filtre a juice, it becomes muddy; repeat the process, it still grows muddy; and, after all, it continually deposits white fecula.

4. Albumen turns the juice of violets green, and alters reddened turnsol to blue.

White fecula washed produces none of those alterations. And how should it? The juices of cabbages, hemlock, and many others, redden turnsol. But albumen has not the property of imparting a green colour by itself; for that purpose, it is well known that a mixture of alkali is requisite.

5. Alkohol separates from the water of albumen light, transparent, glary flakes, which appear on the filtre like boiled white of egg. The juice of plants with alkohol

yields

yields only a whitish opaque powder, which soon settles to the bottom of the vessel.

6. All acids, hydro-sulphureted water, and ammonia, precipitate fecula dissolved in juices; but these re-agents make no alteration in water of albumen.

Oxygenated muriatic acid precipitates and oxydates white fecula; the same acid at first oxydates and then precipitates albumen.

7. Crystallized carbonate of pot-ash, of magnesia, marine salt, muriate of pot-ash, sal-ammonia, salt-petre, &c. thrown into a filtered juice, precipitate the fecula as they are dissolved. The water of albumen is not rendered turbid by any of those salts.

Consequences.

The white fecula deposited spontaneously or by alkohol, acids, salts, &c. is insoluble in water. It is the contrary with albumen; the acids which precipitate fecula, make no alteration in the solution of albumen.

No salt is capable of separating the albumen from water; but fecula combines so imperfectly with water, that any of them can effect a separation by precipitating it.

White of egg dried and again softened is restored to the volume, opacity, and colour of boiled albumen: white feculæ on the contrary become extremely brown. Most of them even turn quite black in drying, as those of cresses, cabbage, *solanum licopersicum*, &c. and if they grow soft in water, yet they never assume the same appearances in it as are known to belong to white of egg. In short, this fecula is nothing but part of the gluten which constitutes the basis of green feculæ. For example, if we compare the fecula of white cabbage, separated by filtration, to that which its juice yields by heat, when both are cleared from their colouring parts, there is not the smallest difference

ence between them. But it is the white fecula that dissolves the most easily, because it is not, like the green, in a state of combination which prevents it. All plants contain a portion of gluten which, having never been called into action by the light, remains colourless.

Cabbages, endive, cellery, and plants blanched by art, likewise furnish white fecula, but in far less quantity than if they remained green. The stalk of the cabbage and of hemlock give a pale fecula compared with that of their leaves. But in general, it is not necessary that vegetables should be externally high-colored to prove that they are rich in gluten. Houseleek yields an abundant, highly-coloured fecula, and particularly rich in wax as will presently be shewn.

VIII. But albumen (it may be urged) being the only product observed to possess the property of coagulating by heat, it appears to be a natural conclusion that, &c. But milk of almonds likewise coagulates by heat, alkohol, acids, &c. It is a fact that has always been known in pharmacy, and yet from this circumstance it has never been concluded that emulsions contain white of egg, because even if characters of animalisation were perceived in the principle of the emulsion, they would require to be combined with other striking marks of resemblance, in order to be considered albuminous *.

* The comparison made by Rouelle of the green juice of plants to an emulsion, was much better founded than he imagined. The cheese separated from milk of almonds by one of the above methods washed and dried, affords oil by expression, and afterwards all the products of caseum by distillation. This is doubtless the reason why almonds and all kernels give so great a quantity of azote with nitric acid.

Milk of almonds contains gum, a small quantity of extractive matter and sugar, which is either of the nature of cane-sugar, or of that which I have discovered in grapes, and which I shall describe in treating of fermentation.

It is in the same point of view that the gluten of feculæ must be considered, since it is neither tenacious nor elastic, nor susceptible of fermentation like that of wheat *. Rouelle, in announcing it to chemists as a product analogous to that of wheat, intended to present but a part of the characters which connect them, those only that belong to the nature of the component parts, since there are no external marks of resemblance; therefore, my object in defending the labors of this great master, is rather to retain in this catalogue of his discoveries, that of an animalised matter more particularly found in leaves, than gluten properly so called, because it is this discovery which the author of the *System* has rendered doubtful in his work. Destroy the aggregation of animalised matters, take away their forms from silk, horn, wool, feathers, &c. it is clear that, considered only with regard to their constituent parts, they will form albumen, gluten, fibre, &c. and even if these constituent parts are in all respects the same, which has not yet been examined, although by that method alone they can be distinguished from each other, yet the proportions should be determined in which nature has combined them to give them existence.

But, it may be rejoined, if albumen be not obtained from juices, with characters as distinct as you desire, it must necessarily be ascribed to the extractive matter, salts, and acids that always accompany it, and which must disguise it a little; it is particularly in the mixture of flower and water that it should be sought, to be found of a purity that leaves no doubt of its nature. Let us examine then what this mixture will afford us.

* The gluten of wheat is susceptible of a fermentation peculiar to itself. The gases which are disengaged from it are carbonic acid and hydrogen, very pure and in great abundance.

IX. Flower-water is like juice recently filtered in a state of progressive alteration, and which ceases only when the acid produced by the fermentation of the saccharine principle has precipitated the gluten.

All the acids and salts that we have applied to juices operate in the same manner on the flower-water and alkohol likewise; but not vinegar, because it dissolves the gluten. In short, it is not by coagulation that acids separate the gluten from juices and from flower-water, since ammonia and salts do the same, but rather by seizing upon the solvent of the substance which appears to derive its solubility solely from its fineness, and not from any affinity similar to that which unites gums, sugar, and albumen to water.

Flower-water exposed to a heat of 50 degrees parts with its gluten like the juice of plants. Dilution with a very great quantity of water is equally incapable of imparting solubility to gluten. Upon the application of the smallest degree of heat, it falls of itself.

I collected an ounce of gluten separated by heat from the liquor. I kept it in its humid state; it fermented, and produced vinegar and ammonia. It is now, after a space of two years, a dark cellular mass, with the same smell and taste as the cheese of gluten.

Let us then conclude that albumen has not yet been discovered in vegetables; nevertheless it must not be inferred that it cannot be formed in them as well as in animals. The age in which we live, more fertile in discoveries than any of the preceding, daily demonstrates that there are few products in either kingdom that can be considered as absolutely peculiar to it. Yet it must be admitted that to establish the existence of albumen by the exclusion of gluten from green plants, the learned author of the *System* has relied too much on the feeble support

support of mere appearances. Before he published his ideas on albumen he ought, I think, to have confirmed his first opinion by more conclusive facts than merely that of concrescibility. But we must not forget that in so vast an enterprise as his, it is extremely difficult for an author to form all the materials of his structure with equal precision.

On this account I shall extend these conclusions to other products which Fourcroy has placed, without sufficient examination, among the glutinous substances of vegetables.

There exist, he says, more accurate and positive observations than Rouelle's, on the presence of this glutinous matter in the vegetable texture which forms linen, paper, &c. page 296, vol. VII. To call this passage to the author's recollection will be sufficient; were I to enter more into particulars, it would have too much the air of censure. Fourcroy will, I think, omit it in a new edition, as well as that on the paste of mallows. If the latter has a right to a place among the animalised products of vegetables, we must likewise class among them the paste of almonds, and those of frangipane, eggs, marmalade, &c.

With respect to bird-lime, of which he speaks in the same chapter, every one knows that it is only a kind of turpentine, an inflammable aromatic resin, soluble in alkohol, formed by vegetation in the filamentary texture of the holy-oak, in the berries and perhaps in the bark of the elder, &c. but that it is by no means a glutinous substance.

X. Pot-ash easily dissolves green fecula and divides it into two parts; one of these attaches itself to the solvent, and the other is separated in the form of a green powder, on which even fresh pot-ash produces no effect. This powder, when washed and dried, gives by distillation the

T 2 pro-

products of white wood and linen, but nothing of the nature of ammonia. This is the woody part which trituration introduces into the fecula.

This solution has all the characters of an animal solution; it exhales ammonia and the same kind of smell as wood; it tarnishes silver, and when acted upon by acids, emits effluvia which blacken writing with white metals.

But in this instance, as in the soap of wool, great part of the fecula is consumed which changes the arrangement and proportion of its radicals. Acids separate from it a very small quantity of fecula. The remainder assumes the character of extract which disposes it to combine with water.

Neither alkohol nor acids can separate this new extract from salts. It is fawn-coloured; and muriate of tin forms in it a dark lake-coloured precipitate. The other (the fecula) when collected, washed, and filtered, is still found to possess the extraordinary property of hardening in boiling water.

Alkohol produces with precipitated fecula a much more solid green than with fresh. The cause of this is, that the resin which cannot be destroyed like gluten, combines, in much greater quantity, with that part which has escaped destruction. By distillation, this fecula yields ammoniacal products.

XI. An acid of 18 or 20 degrees abundantly disengages azote from green fecula; a stronger acid easily dissolves it, and separates from it a small quantity of powder, which is the woody residue of the plant.

However sparingly nitric acid is used, crystallized oxalic acid is rarely obtained. It resolves itself into water and carbonic acid.

The solutions of feculæ always contain bitter yellow of welter, sulphuric acid, benzoic acid, calcareous oxalate, and

and tallow. If a solution of fecula charged with iron, that of the solanum lycopersicon for example, be precipitated with acetite of lead, a powder composed of oxalate, phosphate of lead and oxyd of iron, is obtained. By means of the blow-pipe the lead itself is consumed and dissipated, and only a globule of phosphate of iron remains.

When a vegetable product contains azote, sulphur, phosphorus, benzoic acid, tallow, a bitter yellow, and iron in abundance; we may be assured that it belongs to the class of animalised substances.

Of Wax.

XII. Wax is the work of vegetation, and not of bees. I imagine it is by feeding upon the gluten with which it is accompanied in the powder of the stamina that they separate it. This powder yields abundance of ammonia, which induces me to think that it contains gluten; and since I have discovered wax in certain feculæ, I presume that, if this dust were to be treated with nitric acid, wax would be found in consequence.

The fecula of common house-leek furnished it in a quantity that surprized me. This wax is white, dry, brittle, without smell, it cannot be confounded with those sebaceous products obtained from other feculæ, as those of hemlock and solanum. Messrs. Fernandez and Chabaneau examined it to convince themselves of that circumstance, chewed it, and agreed that this product was a perfect wax.

The fecula of green cabbage likewise gave some, but in much less quantity. Wax appears to me to be a varnish, with which vegetation covers plants, without doubt to preserve them from the effects of any moisture that might be prejudicial to them. It is this varnish that divides the rain and dew into silvery pearls on the leaves of cabbages, poppies, and many other vegetables, and gives

gives such additional beauty to our gardens. It is likewise the wax which the curious gardener, in presenting a plumb, a fig, or a grape, cautiously avoids rubbing off with his fingers.

When an orange is taken, at Paris, from the paper in which it has been wrapped from its leaving Portugal, it is found covered with a farinaceous substance that may be taken off with the blade of a knife, when its nature may be ascertained by holding it to the candle and melting it.

The fecula of opium, likewise, contains a tallow which nearly resembles wax in the firmness of its consistence, and which has been discovered by many naturalists.

Finally, raw silk is also covered with wax, which is carried off together with the colour by alkohol, and is separated from the latter by cooling.

Of several kinds of Fecula less known.

XIII. When 5 or 6 pounds of saffron are treated for the sake of the volatile oil and extract, in the decoction is perceived a fine powder which renders it turbid, is deposited, and may be separated by filtration. This powder, when washed, assumes in drying the horny quality of green feculæ in summer; it quickly putrefies, and breeds worms if not taken care of. This fecula yields, by means of fire, all the products of gluten. With alkalis and lemon-juice, it stains silk a very brilliant yellow.

Borage.

A plant may contain gluten in two states, in the fecula, and dissolved in its juice by means of pot-ash. Such is the juice of borage. When clarified, it is thick, and of a light blue colour, a few drops of acid separate from it a cheesy curd, which may be collected on the filtre, and which is nothing but gluten.

Elder.

Elder.

Its berries, together with a highly coloured, very gummy, and somewhat saccharine juice, contain a fecula as green as that of spinach, when completely cleared of the red colour. Alkohol extracts from it a green tincture; the remainder is a gluten differing in no respect from that of fecula.

In crushing these berries, their gluten attaches itself to the fingers; it has the same consistence as that of the holy-oak: their juice, when left to ferment, gives a small quantity of spirit of a disagreeable smell. It is followed by an astonishing quantity of excellent distilled vinegar.

Buck-thorn.

Its juice which contains a bitter, nauseous, extract, gum, and a small quantity of sugar, is thickened with a greenish slime, of which it is deprived by heat and fermentation. This pulp, when well-washed, is of a bright green, and consists of gluten mixed with a small quantity of fibre. It yields carbonate of ammonia, &c.

The Rose.

Its petals, triturated, yield a fine light coloured fecula, which affords the same products as gluten.

Grapes.

They contain an abundant fecula, which forms the lees of wine; but if I were to treat of this product, I should anticipate what I shall have to say on fermentation. In short, gluten exists in quinces, apples, and, doubtless, in other fruit; it is contained in acorns, Spanish chesnuts, horse-chesnuts, rice, barley, rye, pease, and beans of all kinds. I shall return to this subject in treating of the difference between sprouted wheat and that which has not undergone this operation.

Memoir

Memoir on the various Alterations produced in Muriates of Mercury by the Action of different Bodies.

By M. Boullay, *Apothecary of Paris.*

From the Annales de Chimie.

Having frequently had occasion to remark that superoxygenated muriate of mercury undergoes a more or less considerable alteration in the different liquids with which it is mixed for the purposes of medicine, I thought it would be useful to the physician to ascertain the degree of alteration, and at the same time serviceable to chemistry, to discover the precise manner in which different bodies act upon that salt. For this purpose I undertook a series of experiments, and I shall give the details of those more particularly interesting to chemists and physicians. The former will find in them many facts which do not agree with those already published. The latter will see that it is not indifferent whether this or that medicinal substance, or excipient, be mixed with the corrosive sublimate. They will discover the causes of the inefficacy, and frequently dangerous consequences, of this medicine, in the hands of quacks.

Preparation of the Corrosive Sublimate employed in the various Experiments.

I introduced oxygenated muriatic gas into a bottle three-fourths full of distilled water, in which I had, previously, diluted oxydated mercury. When the solution was complete, I evaporated the liquor, which being brought to a proper degree of concentration, furnished, when cold, very beautiful, pointed crystals, of superoxygenated muriate of mercury.

N. B.

N. B. I employed this process, in order to procure the salt at the highest degree of purity. The purest sold in the shops always contains about a hundredth part of mild mercury, which may easily be separated, as it cannot be dissolved.

Action of Light.

Experiment I. Ten grammes of this salt, in crystals, were put into a glass phial, and exposed to the sun's rays, at a temperature varying from 30 to 40 degrees of the centigrade thermometer. They soon became efflorescent, and, in a month's time, were of a dirty-grey colour; they had lost their regularity of form, and had produced small crystallizations, which had attached themselves to the edges, and even the outside of the phial. In this state they were diluted with warm, distilled water, which dissolved them, leaving a greyish pulverulent residuum, weighing, when dried, two grammes: it was insoluble in water, either warm or cold, in alkohol, and acetous acid: it turned a piece of gold white when rubbed upon it.

The solution still contained some of the salt in the state in which it had been employed.

Experiment II. I put a like quantity of the crystals, of the same salt, into a phial, and placed it in a cupboard, from which the light was excluded. They only became efflorescent, and when dissolved in water left scarcely any residue.

Experiment III. Ten grammes of the same muriate were dissolved in ten parts of boiling distilled water: this solution being put into a bottle, which it filled almost entirely, crystallized as it became cold. A small tube was affixed to it, communicating underneath with a bell full of water. The bottle was exposed to the sun

for the same time as in the first experiment. On the first day part of the crystals was re-dissolved, in consequence of the heat; the others separated, and gaseous bubbles displaced part of the water in the bell. The crystals which had resisted the dissolving power of the sun's heat lost their transparency, and were covered with bubbles, which rose, with the slowest motion, to the surface of the liquid. Viewed through a magnifying glass at the time when it was heated by the sun, the liquor appeared like a collection of extremely diminutive bubbles. I several times examined the gaseous fluid introduced underneath the bell; it always exhibited the characters of atmospheric air.

Wishing to bring the experiment to a conclusion, I unluted and introduced the elastic fluid contained in the upper part of the bottle, under a bell: I plunged into it a lighted taper, the flame of which burned considerably stronger; but not so strong as in pure oxygen gas. I poured tincture of turnsol into the solution which was very perceptibly reddened by it.

The saline part was dissolved in hot distilled water, and left, as a residue, only a gramme of a pulverulent deposit; similar, in every respect, to that of Experiment I.

Experiment IV. For the sake of comparison I placed a like quantity, prepared in the same manner, in a dark place. There was no disengagement of gas; a few crystals were separated, without losing any thing of their excessive whiteness, and were completely dissolved at the conclusion of the experiment by the aid of heat.

These experiments prove, decisively, the action of light on super-oxygenated muriate of mercury; the results of which are the extraction of a small quantity of oxygen and acid, and the formation of mild mercury.

Action

Action of Charcoal.

Experiment I. I took two parts of charcoal, separated from the carbonate of soda by phosphorus, and mixed with one part of oxygenated muriate of mercury, both in powder. To these I added a sufficient quantity of distilled water to form, altogether, an almost solid mass; which was left for a month in a dark, cool, place. This paste was then boiled, alternately, in distilled water, alkohol, and acetous acid. The corrosive sublimate was completely dissolved in the water; the two other agents produced no effect upon it. The residue dried, and, heated in a retort, yielded globules of mercury, and vapours of muriatic acid.

Experiment II. Pieces of light and well-burned charcoal, were plunged into a solution of corrosive sublimate, and left, in that state, an equal length of time with the former experiment. This charcoal, taken out of the liquid and dried, appeared covered with a white efflorescence; it was washed in distilled water, which detached, but without dissolving, part of the efflorescence. This white, pulverulent matter, settled at the bottom of the water, and was mild mercury.

The liquor which had been employed for the experiment still contained a great quantity of corrosive sublimate.

Experiment III. A mixture of two parts of pure charcoal with one part of corrosive sublimate, in powder, was introduced into a fluted glass retort, provided with a recipient, communicating with a bottle filled with pure water. The retort was gradually heated, at a reverberating furnace, till it began to melt. The produce was a very small quantity of corrosive sublimate and of mild mercury, in the upper part of the body of the retort. The neck

contained grey oxyd of mercury and globules of that metal. In the ball which served as a recipient were deposited liquid mercury and muriatic acid. The water in the bottle was likewise slightly impregnated with that acid.

This first trial encouraged a hope that I should effect the total decomposition of the salt by charcoal, and that it would afford a method of accurately analyzing that salt by the separation of its constituent principles. I therefore tried the following experiments.

Experiment IV. I took 10 grammes, or 100 decigrammes, of oxygenated muriate of mercury, and twice that weight of pure charcoal. I incorporated them in a porcelain mortar, with a sufficient quantity of distilled water to form a solid mass, which I introduced in small portions into a porcelain retort. I heated it very gradually till I had extracted all the water employed for incorporating the two powders. This water when examined was extremely pure, forming no precipitate either with lime-water or sulphureted hydrogen, and left no residue by gentle evaporation. I then changed the recipient; to that adapted to the mouth of the retort, I joined a bottle with three necks, two-thirds full of a solution of crystals of nitrate of silver, and which I made to communicate with another bottle, containing a very considerable quantity of lime-water. From the latter bottle a tube conducted to the hydro-pneumatic apparatus.

The apparatus being thus arranged, I applied a gradual and long continued heat to promote the reciprocal action of the oxygen on the charcoal and the muriatic acid on the caloric. When the operation was concluded, I found in the neck of the retort, and in the first recipient, 76 decigrammes of liquid mercury and two decigrammes of grey oxyd of the same metal; in the first bottle

bottle a deposit of muriate of silver, which, when dried, weighed 72 decigrammes. This quantity, according to Bergman, produces 18 decigrammes of muriatic acid. In the bottle of lime-water was a carbonated deposit which, when dried, weighed 10 decigrammes.

The carbonic acid of this calcareous carbonate did not contain all the oxygen disengaged from the corrosive sublimate, part of which had passed in its gaseous state underneath the bell: the whole quantity amounted to three or four decigrammes.

According to these results, 100 parts of corrosive sublimate would be composed of

Mercury	78
Muriatic acid	18
Oxygen	from 3 to 4

I state these proportions not so much as an accurate analysis of this salt, as because they prove the complete reduction of muriates of mercury by charcoal, although they likewise clearly demonstrate that the corrosive sublimate contains a much greater quantity of metal, and less muriatic acid, than Bergman asserted.

This decomposition of corrosive sublimate by charcoal appears to have been hitherto thought impossible, since M. Fourcroy, in his *System of Chemical Knowledge*, under the article *Corrosive Sublimate*, has the following expression; "*Carbon does not act upon this salt, either cold or hot.*"

Action of Phosphorus.

Into a small glass retort I introduced 10 grammes of super-oxygenated muriate of mercury dissolved in a sufficient quantity of distilled water, and added five grammes of phosphorus, which was covered to the depth of two inches

inches by the liquid. The retort being placed on a sand-bath, with a suitable apparatus, was heated till half of the liquid had passed into the recipient. I then unluted and examined the produce, which was pure water; what remained in the retort was poured into a glass for experiments. It was composed of a blackish, phosphorescent, and very combustible matter, shining like carburet of iron: by friction, white smoke of phosphoric acid was disengaged from it, and very small globules of metallic mercury were observed interspersed among it. This matter, weighing about 10 grammes, was considered to be phosphuret of mercury, with excess of metal, like what Pelletier had obtained by the action of phosphorus on red oxyd of mercury.

The super-natant liquor, this phosphuret, was very clear, and had somewhat of the smell of phosphorus whilst burning, and a very strong acid, but not the least metallic taste. With lime-water it precipitated white and very light flakes, which instantly dissolved again, excepting a great quantity of this re-agent was added. It contained no mercurial salt, and nitrate of silver demonstrated the presence of muriatic acid in abundance.

On the subject of the action of phosphorus on corrosive sublimate, M. Fourcroy only says that this salt is decomposed by phosphorus, but less speedily than by nitrate of mercury, the latter salt having less affinity with its basis; but as he is silent respecting the results of that experiment, of which I have no where seen a description, I thought I ought not to omit the statement of that which I made, and of the method it affords of procuring phosphuret of mercury.

Action

Action of Acids.

Nitric acid, with the assistance of heat, dissolves corrosive sublimate and precipitates it as it cools without alteration, in the form of irregular crystals. Bergman announced this solution of nitric acid, but Fourcroy speaks of a disengagement of oxygenated muriatic acid, which I could not perceive in this experiment, though I repeated it several times.

Action of the same Acid on mild Muriate of Mercury.

Experiment I. Into a small retort I put one ounce or 32 grammes of mild mercury, two ounces or 64 grammes of pure nitric acid, at 36 degrees, and half an ounce (16 grammes) of distilled water. To this retort, placed in a reverberating furnace, I adjusted a globular recipient, corresponding with the pneumatic apparatus by means of a tube with several curves. I heated the nitric acid till it boiled: in the first moment of ebullition the retort, and afterwards the rest of the apparatus, were filled with red vapours of nitrous acid gas; at the same time a perfectly white liquid passed into the recipient; no air but what had been expanded in the vessels was conducted under the bell. As soon as the solution of the muriate was complete, I stopped the operation. The retort, when cold, contained a clear liquid, covered with a saline pellicle, which being broken by shaking, was precipitated on a considerable quantity of irregular crystals that had been formed. These crystals were very pure corrosive sublimate.

I again adjusted my apparatus, and applied a very moderate heat to it; no more nitrous vapours passed over; the saline matter in the retort was dried up, when a very white salt, in the form of beautiful needles, was

sublimed,

sublimed on its surface. As soon as the sublimation appeared to have ceased at that heat, I put out the fire, and broke the retort with great care. It contained at the top and in the neck about 15 grammes of dissolvable salt, possessing all the properties of very pure corrosive sublimate. In the bottom of the retort was a yellowish matter, weighing about 18 grammes: this matter being broken to pieces was introduced into a small phial, which was placed on a sand-bath, and heated for an hour, during which time thick vapours were disengaged from it. The phial being broken, its neck was lined with a saline matter, weighing 18 grains (about 1 gramme): this I discovered to be corrosive sublimate, and when added to what I had before taken off, made a total of 16 grammes 6 decigrammes. The bottom of the retort contained about $3\frac{1}{2}$ gros of very fine red precipitate, the produce of 4 gros 18 grains (16 grammes 8 or 9 decigrammes) of dried nitrate of mercury. Thus an ounce of mild muriate of mercury, treated with two ounces (about 64 grammes) of nitric acid, gave the following result:

Corrosive muriate of mercury	4 gros	40 grains.
Dried nitrate of mercury .	4	18

N. B. The augmentation in the weight of the ounce of saline matter employed is owing on the one hand to the fixed oxygen, and on the other to a portion of nitric acid.

It is easy to account for what occurred in this operation.

The mild mercury employed was a muriate composed of a great quantity of mercury a little oxydated.

The corrosive sublimate obtained is a muriate saturated with oxygen and acid.

The

The former salt must therefore necessarily have passed to the state of the latter, in order to lose part of its own basis to gain that of oxygen.

Hence we see: 1. That the nitric acid employed lost its oxygen, since it gave out red vapours.

2. That it seized a portion of the metal, relatively more considerable in the mild mercury, since it formed nitrate, and afterwards red oxyd of mercury.

3. That the muriatic acid, being obliged to concentrate itself in a less quantity of mercury more highly oxygenated by nitric acid, again formed corrosive sublimate, but only in a quantity proportionable to itself.

What would have been the consequence if this quantity of muriatic acid had been more considerable will be shewn in the following Experiment.

Experiment II. To the two substances employed in the foregoing experiments, I added 1½ ounce of pure muriatic acid, and conducted the operation in the same manner. At first there was a disengagement of vapours of oxygenated muriatic acid, (as is the case when muriatic and nitric acid are mixed together,) and afterwards of very great quantities of nitrous acid vapours. At last 1 ounce 50 grains of very fine oxygenated muriate of mercury was sublimated: at the bottom of the retort I found nothing but a residue of a few grains only.

This experiment appeared interesting to me: 1. Because it accurately determines the action of nitric acid on this muriate of mercury in a manner perfectly new, as M. Fourcroy, the last writer that has treated of it in his "System of Chemical Knowledge," vol. V. p. 351, positively says, when speaking of the mild muriate of mercury, *Nitric acid does not convert it into corrosive sublimate.*

2. Because it may afford a method of obtaining, at one and the same time, and with facility, two very valuable

 articles,

articles, corrosive sublimate and red precipitate, if mild muriate could be procured by a more economic process than those with which we are yet acquainted.

Action of the Distilled Waters of Plants.

Distilled waters, even those called inodorous, disoxydate the mercury of corrosive sublimate more or less *. This alteration is the more striking because they contain volatile oil in solution.

Experiment I. Five decigrammes of corrosive sublimate, dissolved in distilled water, were poured into four hectogrammes of peppermint, recently prepared. This liquor, left at a temperature of 16 to 20 degrees of the centigrade thermometer, appeared, in a few hours time, like Seine-water, rendered turbid by a heavy rain; and in the space of two or three days it had become clear, but had precipitated a flaky deposit, of a greyish colour, insoluble in hot water, and even in alkohol, (both of

* I use the expression, *disoxydate the mercury of the corrosive sublimate*, instead of *disoxygenate the acid* of that salt, for the following reasons. 1. Corrosive sublimate is reduced, at a high temperature, by alkalis, calcareous earth, &c. in muriatic acid, which combines with those bases in liquid mercury, that become volatile when separate.

2. By the action of mineral acids on that salt, no oxygenated muriatic acid is disengaged.

3. Simple muriatic acid dissolves the red oxyd, (precipitate *per se*), without any disengagement of oxygenated muriatic acid; therefore the acid of this saline substance is not in an oxygenated state, but in that of simple muriatic acid, combined with mercury more oxydated and in smaller proportions than in mild muriate.

This opinion, lately advanced by M. Proust in a memoir inserted in No. 126 of the *Annales de Chimie*, I profess, in common with him; and I had communicated it to several persons, prior to the publication of the memoir of that learned chemist, and had likewise mentioned the necessity of giving that salt the more accurate name of superoxydated muriate of mercury.

them

them being but slightly tinged by the vegetable matter precipitated, at the same time, as the metallic salt), it was insoluble in acids, cold; and was, in short, real muriate of mercury very little oxydated.

The liquor, separated from the deposit, was very clear, and had little smell; it formed no precipitate with lime-water, and only turned a little brown with hydro-sulphuret of ammoniac.

Experiment II. The same experiment was made with the distilled water of lettuce and of borrage: they precipitated mild mercury in two or three days; at the same time continuing to hold the mercurial salt in solution.

Action of Alkohol.

Experiment I. A saturated solution of corrosive sublimate in alkohol was left in a bottle well closed, at the ordinary temperature of the atmosphere, for four months. It had then deposited, in the state of mild mercury, about half the metallic salt it contained. The liquor had acquired a strong smell of ether, and reddened tincture of turnsol.

Experiment II. A like solution was heated till the alkohol was completely, but slowly evaporated: the coloured residue was corrosive sublimate mixed with an eighth part of mild mercury.

Experiment III. A like solution was set on fire; while burning, it emitted a white smoke, which being collected in a paper cone was saline and dissolvable. About half a gramme of mild mercury was left at the bottom of the vessel.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

Sweeping Chimneys.

A MEETING of the President, Vice-Presidents, &c. of the Society for superseding the necessity of Climbing Boys, by encouraging a new method of sweeping chimneys, and for improving the condition of children and others employed by chimney-sweepers, was recently held at the York-Hospital, Westminster, according to appointment, for the purpose of examining and seeing the several machines worked by the under-mentioned candidates for the premium for sweeping chimneys.

The first machine introduced, was one by Mr. Orme, late an officer in the army, being a brush, curiously constructed, upon the end of an elastic pole, composed of whale-bone, with two projecting wings, made of strong leather; the end of which was lined with steel, to form a scraper. To the pole were superadded various lengths, made of the same materials, and wrapped round with a cord, resembling the handle of a drayman's whip, and so contrived, that by the elasticity of the pole, joined thus together, and suspended from the brush, it took the chimney in all directions. The chimney to the top was forty-five feet high, and in three minutes the machine, thus contrived, completed the operation.

The second was by Mr. Barber. His machine was also fixed upon the end of a pole, being six brushes, forming a sugar-loaf, with a scraper affixed to each brush, being so well contrived, that, when the machine ascended to the top of the chimney, by the smallest touch in pulling a conducting cord, the whole of the brushes spread in their several directions, so as completely to fill the flue and crevices

crevices of the chimney, with a scraper and brush extended in every direction.—This machine ascended the chimney by the assistance of several pieces of wood, occasionally linked together, at the extremity of each link, which formed an angle, with a caster or roller at each angle. The machine in its experiment, by some accident, broke the chimney-pot, and left the brush at the top; but on the second trial, in a back parlour, it completed the design in five minutes.

The third competitor was a Mr. Griffin. His instrument was formed with a coarse brush, nearly in the same manner as the preceding, with the exception of a spring, and a top brush, which was to fall over the chimney-pot, but by some defect he could not raise the machine.—During this time, Mr. Orme observed a small baking-oven, with a flue to it, and in less than three minutes he, by his above-mentioned machine, completed his experiment, by sending his brush, &c. to the top of the chimney and down again.

The fourth was a Mr. Davis; he began his experiment ten minutes before eleven. His machine was nearly constructed the same as that of Mr. Barber's; forming only four brushes, with a serger affixed immediately before each brush, with inflexible joints, and several pieces of lath-wood, forming an handle; by the addition of these handles, it ascended the chimney, 45 feet, in six minutes, and completed the operation. By our List of Patents last month it will be seen that Mr. Davis has obtained a patent for this invention.

The fifth and last candidate was a Mr. Smart. His machine was a brush forming five squares, upon the end of a hollow pole, through which was a small rope, and was followed by a vast number of short lengths of wood, with a hole

hole and rope through each; at the end of each of those pieces of wood there was a piece of brass, forming a kind of bell, the end of each piece followed in succession, into the groove of each of those bells, so as to make them stationary; and by tightening the rope, which was done by a pully, they became substantial, and yet so pliable as to take the zig-zag of the flue; but, by some mischance, one of the pieces of wood broke; and notwithstanding he had tried the experiment before with success, in this instance he failed.

Durham Agricultural Society.

A society has lately been established called the Society for Experimental Agriculture, in the county of Durham; the objects of which are stated to be:

1. To examine, by experiments, the differents kinds and merits of grass, seeds, and grain; to investigate their habits, and endeavour to ascertain what soils are best adapted to each kind, and to devise means to obtain such seeds, &c. pure.

2. To attend carefully to the rearing of fences, draining of land, and the best and most expeditious way of cleaning and working different soils.

3. To examine the nature of different manures, and ascertain the best mode of applying them.

4. To find what stock is best calculated for certain situations; to compare the relative quantities of food consumed by different kinds of stock; what food is most congenial, &c.

By the rules of this society it is limited to twenty-one members, and it is to meet four times a year at Rushyford. When any member undertakes an experiment adopted by the Society, two members are to be appointed

as

as visitors to view with him the state of the land previous to the experiment, inspect its progress, and report the result.

The President for the year 1803 is Sir Henry Vane Tempest, Bart.; and two meetings of the society have already been held, on 1st of April and 1st of June.

Spanish Wool.

It has been proved, by his Majesty's Spanish flock, in ten years experience, that the wool of that breed does not degenerate in this country. It is ascertained that the first cross of a new breed gives the lamb half of the ram's blood; that the second gives 75 *per* 100; the third 87½; and the fourth 93¾. The difference between the fleece of the original stock and the wool of the mixed breed is then scarcely perceptible, particularly if attention has been bestowed on the selection of the ewes.

Substitute for Soap.

In the eleventh number of the Repertory of Arts, &c. we published Mr. Vancouver's specification of his patent for a method of preparing an earth, found on Lord Warwick's estate, to be used as a substitute for soap, and particularly for cleansing wool. A similar kind of earth, and possessing the same detergent properties, is found in many parts of the Yorkshire Wolds; it is composed of clay, sand, and the oxyd of iron, and it is used for wash-balls. The only difference between them appears to be, that in Warwickshire the earth is of a green, grey, lilac, or white colour, whilst that of Yorkshire is generally of a yellowish-white. The former is held together by a strong size; the latter has hitherto been seldom used in washing linen, as it rapidly dissolves in water, but that defect has been corrected by the mixture of glue.

List

List of Patents for Inventions, &c.

(Continued from Page 80.)

ELIZABETH BELL, of Hampstead, Middlesex, Spinster; for a method of sweeping chimneys, and of constructing them in such a manner as to lessen the danger and inconvenience from fire and smoke. Dated May 10, 1803.

GEORGE BEAUMONT, of South Crossland, near Huddesfield, Yorkshire, and WALTER BEAUMONT, of the same place, Manufacturers of Woollen Goods; for a mixture to be used in the preparation of sheep or lambs wool, for various purposes. Dated May 17, 1803.

JOSHUA GREEN, of Banbury, Oxfordshire, Manufacturer; for a method of manufacturing corded and ribbed shags, or plushes, composed of different materials, on a principle entirely new. Dated May 17, 1803.

JAMES ROCHE, of King-street, Holborn, Middlesex, Gentleman; for a medicine for the cure of the hooping cough. Dated May 23, 1803.

CHESTER GOULD, of Red Lion-street, Clerkenwell, Middlesex; for a glass on a new principle, to be used by mariners at sea, instead of the common sand-glasses when heaving the log, for the purpose of ascertaining the ship's rate of sailing; and also for other uses, either on land or at sea. Dated May 28, 1803.

THOMAS FULCHER, the elder, of Ipswich, Suffolk, Surveyor and Builder; for a water-proof composition, in imitation of Portland-stone, for stuccoing and washing new and old stone, and brick buildings; and for cementing the joints, and tucking and pointing all stone and brick works that require proof against water and damps. Dated May 28, 1803.

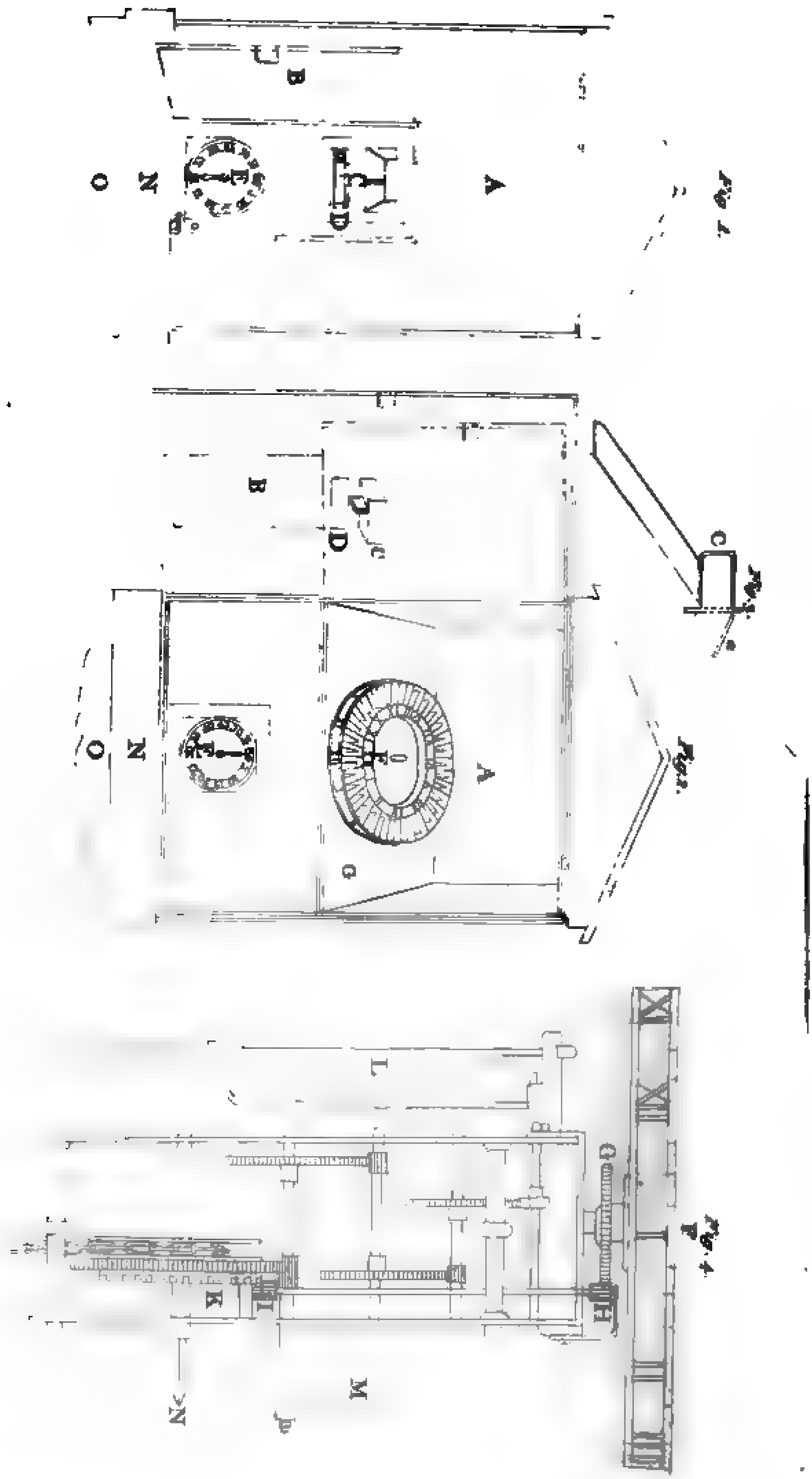


Fig. 1
Fig. 2
Fig. 3
Fig. 4

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XV. SECOND SERIES. AUG. 1, 1803.

Specification of the Patent granted to SAMUEL DAY, *of Charter-house, Hinton, in the County of Somerset, Esquire; for a Watchman's Noctuary, or Labourer's Regulator.* Dated April 20, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Samuel Day do hereby declare, that my said invention of a watchman's noctuary, or labourer's regulator, is described by the drawings annexed, and references thereto, and in the following explanation; that is to say: My invention consists partly of a large horizontal wheel, that is moved regularly round every twelve hours by clock-work. The upper side of this horizontal wheel is divided by two circles, one within the other (see Plate VII.); the outer one or periphery having the

hours and quarters marked on it, which may be called the *lateral dial*, the inner circle having also a dial, which may be called the *vertical one*. The space between these circles or dials is divided into cells, each cell corresponding with a quarter or half an hour of the different hours marked on the dials; and if thought proper, the cells might be so multiplied as that each would correspond within a period of five minutes. Such is the upper side of the horizontal wheel, which may be made of copper or tin, or of various other materials, and is of the diameter of nine inches. The under side of the same has a brass wheel, with teeth, of the diameter of three inches and a quarter, fixed to its central part; the teeth of which, letting in with those of a smaller wheel or pinion, of course give movement to the large horizontal wheel (of which it forms a part) by the motion it receives from the pinion. This pinion being set in motion by the common clock-work and a weight or spring, the revolution of the horizontal wheel is completed once in twelve hours, and thus regularly going round, will at all times shew the time of day or night. As it moves round it carries the cells above mentioned under a kind of chink, just large enough to receive a token of the size, we will suppose, of a farthing. This chink sinks down from an external brass box, which is sufficiently large to admit a man's fingers to let in the token by an external aperture or mouth of the chink; the token being directed perpendicularly through the above-mentioned deep chink into such cell as is immediately under it, and which must correspond with the time of night or day. The head of the case of the machine has double doors in front (see Plate VII.); the outward door covers the whole face together, with a space over it sufficiently large to admit a man's head, to examine the horizontal wheel for such tokens

kens as have been dropping into it; a smaller door opens in this large one, upon the brass box above mentioned, the opening of which belongs solely to the watchman, or such other persons who may be required to use the same, for the purpose of seeing the time and dropping his tokens, a minute-dial being placed under the hour-index. The great outer door first mentioned is only to be opened by the master of the time-piece, and ought to be well screwed; but for greater security, both against thieves and weather, there is an inside door, in which the brass box above mentioned is fixed; and this inner door being open throws into view the horizontal wheel, for the purpose above mentioned. For fixing the pendulum, weights, &c. in the middle of the case, the door may be in front, as in a common clock-case, or in the back or side, as most convenient. It may be observed, that the machine is fixed to a board, and dove-tailed into the bottom of the head of the case; and that the head of the time-piece is let into another board under the great wheel G, whereby it is kept perfectly steady, so as to withstand almost any shock it might receive. To denote more fully the several parts of the said machine, references are added to the drawings as above. G, as above, is in Fig. 2.

The advantages to be derived from this time-piece are various and striking; but I shall only mention some of the principal. It appears then, that by placing one of these machines at each extreme end of a watchman's round, and obliging him as he passes the machine to drop a token (which shall be numbered, and his name stamped upon it) every half hour, quarter, or half quarter, as the vigilance of the place shall require, you will find the test of the man's duty and diligence according to the time he has been employed; no trick or contrivance on his

 part

part can counteract the movement of the horizontal wheel, over which he has no command; and each cell (as it moves under the chink or drop) is a kind of speaking witness of his diligence and fidelity in going his round, and will answer the next morning to the exact times he either was or ought to have been there. The same machine will answer in custom-houses, warehouses, banking-houses, and every place where watching to be useful must be exact; even centinels on military duty might be required to leave tokens often, as memorials of their vigilance. It often happens that the excise requires great exactness as to time in the duty of their officers, particularly in their visits to distillers, maltsters, &c.; one of these machines would indicate to five minutes, if placed at such houses, at what time the officers had been there, and no fraud could be practised. Another use may be derived from it by farmers, manufacturers, ship-carpenters, and others, who employ many labourers, by giving them to know at what hours in the morning, evening, &c. their men come and leave their work; and by a small variety in their form and direction of the drop, the time-piece may be placed in the inside of a house, where it would answer all the purposes of a common eight-day clock, (as it goes eight days), and at the same time give intimation of servants or labourers coming to, or going from, their work: this is done by means of the drops passing through the wall of the house into the cells of the clock, and by changing the situation of the figures on the superficial dial-plate The scale of the machine may be enlarged to any degree, so that the horizontal wheel might be made large enough to receive the tokens of several hundred men; and striking movements may be added to any of them at pleasure.

In

In addition to the above explanation of the drawings, it is proper to observe, that the projection under the brass box C, Fig. 2, is a guide from the chink to the receiving wheel, to keep the tokens upright in their fall to the cell. The said guide must be kept full half an inch from the receiving-wheel, and the tokens must be as broad as a farthing. It is thought unnecessary to give a scale of inches to the above drawings, as the horizontal wheel is taken at nine inches, the other parts must be in like proportions.

In witness whereof, &c.

Explanation of the Drawings.

(See Plate VII.)

A, Fig. 1, shews the outside of the machine, or the box that encloses it, which is shut up by two doors.

B, shews a small door, open, for the watchman to put in his token.

C, shews the opening, made of brass, in which is the chink to put in the token.

D, shews the edge of the horizontal wheel to receive the tokens, which shews the hours and quarters as it goes round.

E, a minute-dial, the place to put in the tokens at, and is proposed to be placed about five feet and a half from the ground, as a convenient height for the weight of the clock, and the person to put in his token.

Fig. 2, A, shews the inside of the box above the clock, (with the two doors open), and the horizontal wheel that moves round every twelve hours to receive the tokens.

C, is the back part of the brass box that goes over the wheel (that receives the tokens), when the door is shut.

D, the

D, the opening with glass that comes before the edge of the wheel that shews the hours, and correspond with D, in Fig. 1.

E, the minute-dial.

F, the horizontal wheel.

B, the small door, open.

Fig. 3, C, is the section of a box to put in the token when it is intended to be used on the outside of a house, and to go through a wall to a clock and token-wheel within.

a, door to shut down.

Fig. 4, shews the inside of a clock, with the horizontal wheel to receive the tokens upon it.

F, the horizontal wheel to receive the tokens which correspond with the same letter on Fig. 2.

G, shews a brass wheel, with teeth, moved round by the pinion H; which pinion is fixed to an arbor with a second pinion I; which last-mentioned pinion is moved by the side teeth K, in the first wheel of the clock.

L, the pendulum.

M, the minute-hand.

N, the bottom of the head of the case in Figs. 1 and 2.

O, where it joins the case for the pendulum and weights.

Observations by the Patentee.

From the concurrent testimony of many individuals, the present system of watching cities is languid and inadequate: no house is secure when depredations are determined on, or if there be any security, it is more from the means taken within than from the watching without. Magistrates have seen and pointed out the defects in the

system,

system, and have at times applied what means they could to counteract the evils arising from those defects, but their means have been ineffectual; and householders have been obliged to submit to their risques with no other consolation but that of thinking, that though the plan of watching was bad, it was better than none. In attentively considering the plan, the defects seem to reduce themselves to the following heads: 1st. The too long intervals which watchmen take between their going their rounds;—by which it appears that considering any individual house, that house has not the benefit of actual watching more than ten minutes through the whole night.

2dly. The watchman's call of the hours:—from which no service arises to any but to the depredators of the night, as is obvious to any one who reflects, that of the many hundred house-breakings and street-robberies committed in London in the year, how few of the depredators are detected or taken by the watchmen themselves; from no fault perhaps of these last, but because the thieves have taken advantage of the watchman's repose in his box, and what is more, of the notice which he gives, by vociferation, of his distance or approach, by which they hasten or delay their attack, or carry off their plunder accordingly.

3dly. The uncertainty of the watchman's doing his duty:—who, either from intoxication, drowsiness, or indolence, or induced by the badness of the night, may miss his rounds without detection.

4thly. The use of the lanthorn, which answers no purpose but that of adding to the signal of the watchman's approach.

And, lastly, the use of the watch-box; which answers no end but that of promoting drowsiness, and perhaps disease,

disease; from the chills which are increased by inaction in a cold damp house.

The instrument called *The Watchman's Noctuary*, or *Labourer's Regulator*, offers a remedy for these defects. By one of such being placed at each end of a watchman's round, it will be ascertained how the man continued his movements through the night, to a nicety of ten minutes, at any period of the watch: and the slightest irregularity or omission will be visible the next morning to the inspector or constable, whose office it shall be to open the machine. The test of regular and well-sustained vigilance is given by the watchman's dropping a token as he passes, every half hour, quarter, or half quarter, into a receiver or cell; each half hour or quarter presenting its own cell to receive the same, and each cell, like time itself, irrecoverable when passed. No trick or fraud on the watchman's part can counteract the movement of the horizontal wheel formed of these cells, and completing a revolution once in twelve hours. He has no command over it; and each cell (as it moves under the receiver) will be a kind of speaking witness of his diligence and fidelity in going his rounds, answering the next morning to the exact periods he either was or ought to have been there.

By this means the calls of the watchmen, which were only instituted for the purpose of his giving notice of being on his duty, will be superseded; and a considerable expense of animal exertion will be saved to the individual, which might better be converted into that of going his round twice where he now only goes once. Warnings to the nightly thief of timely attack or retreat will likewise be taken away; and, if instead of an open the watchman was to carry a dark lanthorn, the robber would have no security whatever in calculating the moment of his

his depredation, and might be detected in the very outset of his attack, as the slightest sound would alarm the watchman walking in silence, and not drowning distant noise by that of his own voice.

Of the objections to this new mode of ameliorating the watching of cities, the only one seems to be the expense of the time-pieces; and considering the number which the larger parishes will have occasion for, this expence will be important *; but let it be considered that it will not amount to more than three pence in the pound of a rate on houses, and that the first will be the sole expense — probably to be saved by diminishing the number of patroles to one half (or less) of what they now are. But trifling indeed will be the expense when compared with the losses sustained by the public in depredations, which, according to a late work on the police of the metropolis, amounts to two millions and upwards.

The best situation for these machines will be at each end of a watchman's round; perhaps certain rounds will require three. They ought to stand in a convenient recess in the street, secured by rivetings of iron, or let into a wall, or placed on a strong bracket within the iron railing of an area; and if the dial plates were suffered to appear, would be useful in the day as well as in the night. As an eight-day clock it would require no attention to its movement but once a week, and the morning inspector might attend to the slight duty of winding it up.

The annual expense of keeping it in repair is too trifling to be taken notice of.

* It is presumed that each time-piece will amount to not less than twelve guineas, and each round will require two.

Specification of the Patent granted to JOSEPH JACOBS, *of the Parish of St. Anne's, Soho, in the County of Middlesex, Coach-maker; for a new Metal Box for the Axletrees of Wheel Carriages, Mills, Engines, and other Machines.* Dated January 20, 1803.

With a Plate.

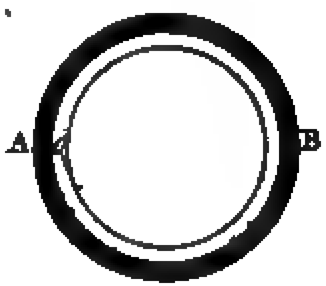
TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joseph Jacob do hereby describe and ascertain the nature of my said invention of a new metal box for the axletrees of wheel carriages, mills, engines, and other machines, as follows: A bar or plate of steel, half an inch thick, more or less, is welded on a similar bar or plate of iron, an inch thick, more or less; the iron and steel being so united, is then passed between the rollers of a flatting-mill till reduced to the thickness required. The metal thus prepared is made into boxes of all descriptions, for the above-mentioned purposes, with the steel side inwards. The form or shape of axletree-boxes vary, but the ends of all being alike except in their dimensions.

The end-view of a steel-plated box is shewn in the margin hereof (see Plate VIII.) A, B, Fig. 1, represents the ends of the steel-plated axletree-box, the white border bounded by the circular lines *n*, *o*, describes the inside of the surface of steel and the dark border. A *n*, the outer surface of the iron. The box may wholly be made of steel, though the inner surface only, which is the wearing part of the box, being steel, is sufficient for every purpose, and upon the whole the best.

In witness whereof, &c.

Specification

Fig 1 Page 170



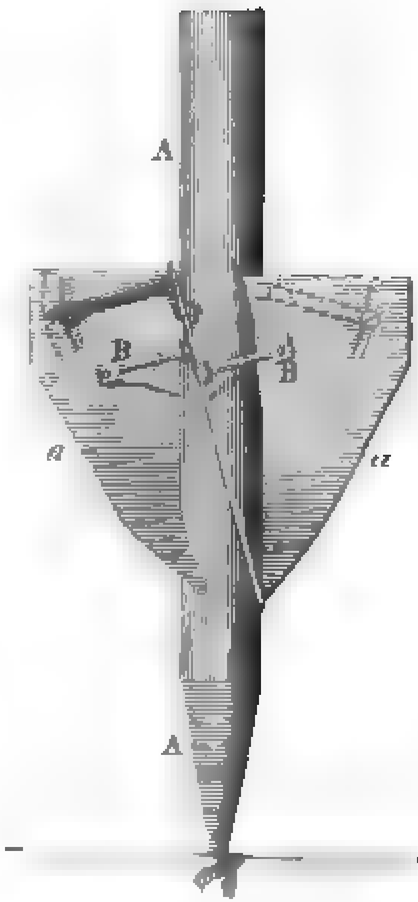


Fig 3.

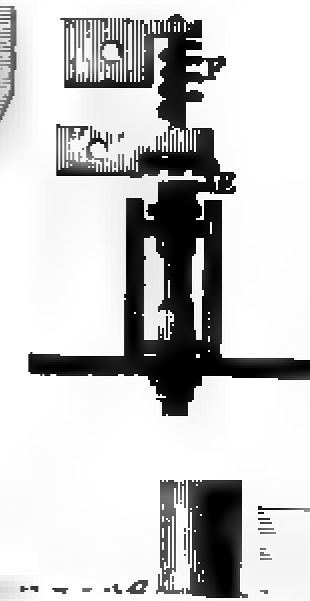
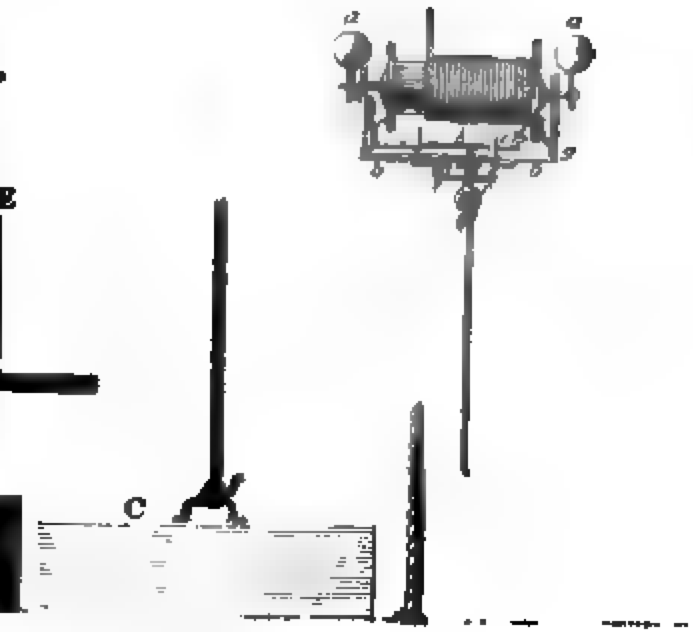


Fig 7



Specification of the Patent granted to EDWARD MASSEY, *the Younger, of Hanley, in the Parish of Stoke-upon-Trent, in the County of Stratford, Watch-maker; for an Instrument or Apparatus for taking Soundings at Sea with more Certainty and Correctness than heretofore, and for other nautical Purposes and Matters connected with, or relating to, Navigation.* Dated March 24, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Edward Massey do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is particularly described as follows; that is to say: Fig. 1, in the drawing annexed, (see Plate VIII.) represents the sounding machine. A A, the sounding weight, about eighteen inches long, the body of which contains a register with two dials. B B, is an iron or brass rod, twelve inches long. C, is a tin buoy, about six inches square and four deep, which must be made air-tight; the particular use of which will be mentioned hereafter. To the bottom of the aforesaid buoy is secured at D D, a pair of spring tongs, one end of which rests on a hook at E, and in the spring part of the tongs at F is fixed a rotator or revolving apparatus G G.

This apparatus is composed of a copper or other metallic tube G G, and four brass or other metallic vanes *g, g*. The tube must be air-tight, and about twelve inches in length and one and a half in diameter, with a conical point, about four inches long. The diameter of this tube may be sometimes less, and the length greater, but the diameter should never be greater than one inch

 and

and a half, as it would increase the resistance by opposing too much surface to the water. The vanes must be soldered, or otherwise fastened, to the tube in a spiral direction, so as to produce a rotatory motion round the axis of the tube when sent in the water. On each vane is fixed a regulator, whose office is (when rightly set on its scale) to make a rotator perform a certain number of revolutions in a given space correspondent with the calculation of the wheels of the register; and if any little accident should happen to the rotator, it may, by experiment in water, be corrected by the regulator. The length of each vane is five inches and three quarters, their breadth at their broadest part is two inches and three quarters, and are brought circularly to a point, as at H. The inner edge of the vane, which is soldered, or otherwise fastened to the tube, is rather more than a sixteenth part of an inch thick, and filed tapering towards the outer extremity, so as to lengthen the regulator, otherwise it would require a longer air tube, as the use of the tube is to make a rotator nearly of the same specific gravity with the water, by which means, by a very small impulse, the rotator will register the true depth. For did not the specific gravity of the rotator form nearly an equilibrium with the water, it would not revolve truly till the velocity was equal to the rate of about four miles *per* hour; whereas, in consequence of the air tube, it will give the true distance at the velocity of about a mile and a quarter *per* hour. I K, represents one of the regulators, nearly the eighth part of an inch thick, with two screws, which secure it to the vane, as at I K; the lower screw K is a fixed centre, and the upper screw I passes through a circular opening at L. The outer point of the regulator is an index, which points to a scale graduated into ten parts. At one end of the aforesaid scale is the letter F,

F, and at the other the letter S. Supposing all the regulators to be standing at S, the rotator, if well executed, will be about a fourth slower than if they were standing at F. When the regulators are standing at S, the angles of the vanes are shortened, which occasions the rotator to move slower in the same place; by moving any of the regulators one degree towards F, it will increase the rotatory motion about one mile in 160. The water increases in its effect on the angles of the vanes in proportion as the regulators are moved towards F; but when brought forward as far as F, the water has nearly its full effect on the angles, so that, were the regulators taken off the vanes, the rotator would go very little faster than if they were all on the vanes standing at F. The regulators on the above principle are very steady, and subdivide each other from S to F.

I adjust the rotators, by experiment in water, to correspond with the registers to the greatest nicety, that is, to ascertain the space the machine will descend by every revolution of the rotator. By altering the angles and size of the vanes, the rotator may be made to revolve in any desired space; but the above-described one I consider very well proportioned for obtaining a true distance in slow motion, making a revolution every seven feet. But as I consider the sounding machine never descends so slow as to require a rotator to be moved by so very small an impulse as the above-described one does, and which is absolutely necessary to ascertaining the progress of a vessel, as hereafter to be described, so that a smaller tube may answer for that purpose. M, is the upper part of an universal joint, to which a rotator is secured by screws N, a support to the drop O O. P, a stud to the drop. Q, a stud to prevent the drop from rising too high. R, is a friction wheel. S, a bevil spring. T, a locking rod.

U, a

U, a guard to the locking rod. V, the locking plate. W W, is a bevil rod and universal joint; the particular use of the bevil is to fling the rotator out of the eddy of the register's wake. The axis to which the bevil rod is made fast is an endless screw, which acts in a wheel of eighteen teeth. On the axis of this wheel is an index, which moves round a graduated circle in every twenty-one fathom, and is marked from one to twenty-one. On the aforesaid axis is a pinion of eight leaves, which acts in a wheel of thirty-two teeth; the axis of which is a pinion of six, and acts in a wheel of thirty teeth, which carries an index round a graduated circle, which is divided into twenty parts, each division answering twenty-one fathoms, and marked from twenty-one to four hundred and twenty fathoms. The use of the tin buoy, as before mentioned, is when the machine is hove in the water, the resistance it meets with on the surface lifts the buoy of the hook E, and the spring tongs F drawing off the tube of the rotator, leave it at liberty to revolve; were it not for the above method of entering the rotator to a certainty in the water, the machine could not be so well depended on. There must be a separate rope tied to the buoy, for the purpose of drawing it back. The lower part of the sounding weight is filled with lead, which runs nearly up to the register.

Now let us suppose the machine to have descended. In the act of drawing the machine out of the water after sounding the rotator, (it having a tendency to fall in a direction of the sounding weight,) presses back the bevil spring S, and the rod W W falls out of the drop O, which likewise falls and brings down the locking rod T, which falls into the locking plate V, and prevents the index from being moved in drawing up the machine.

An

An additional weight may be used to every twenty or forty fathoms of line, so as to prevent it forming an equilibrium with the water; but care should be taken to proportion the strength of the lines so that the last line may be sufficiently strong to draw back the machine with its accumulated weight. By the above method soundings may be obtained in very deep water.

Another particular advantage which this machine has over any before in use is, that soundings may be obtained in twenty fathom water, without the trouble of heaving the vessel to, although she may be going at the rate of five miles *per* hour; for as the rotator registers the descent of the sounding weight, there is no occasion to pay any respect to the length of line out, so that the mariner may veer out any quantity of line, which will give time (as the vessel advances) for the machine to descend. As a means of ascertaining the correctness of the sounding machine, I suggest that the apparatus hereafter described be attached, which I apprehend will be found to give the perpendicular length of line out, or nearly so; but not having determined the effect by experiment, I do not mean to give it as possitive.

Fig. 7, represents a reel, which may be made of brass or wood. I prefer copper for the barrel or cylindrical part, which should be made air-tight, and about twelve inches long and eight inches in diameter; from this it may be increased to any size necessary. *a*, *a*, two buoys, whose office is to keep the cylinder in an horizontal position. *b*, is the frame. *c*, is a bridge. *d*, is a locking plate. *e*, is a bolt. *f*, is a bolt spring. *g*, is a friction spring. *h*, is a pump spring. *i*, is a pump piece, one part of which catches the locking bolt at *k*, and to the other end is fastened a strong line, which I call the horizontal or stay line. The sounding or perpendicular

dicular line being wound round the cylinder, and the machine hove in the water, the reel continues on the surface whilst the sounding weight descends. The mariner must veer out the horizontal line till the sounding weight has arrived at the bottom, the method of determining which will be mentioned hereafter. He must then give the line a sudden pull, by which means he draws the pump piece, and lets go the locking bolt, which springs into the locking plate, and prevents the cylinder from moving any further, and of course stops the sounding or perpendicular line. The machine should then be drawn in, and the length of line let off the cylinder, examined, and compared with the distance marked on the register, which is contained in the body of the sounding weight; and if the mariner finds these accounts to agree, he may be assured he has got a true sounding. The machine may be used with or without a reel, or the reel without the friction or locking spring, which will occasion the machine to descend quicker, but experience only can point out the most proper way of using them. The method the mariner must take to determine the time necessary to elapse before he strikes the horizontal line is as follows. He must, by experiment in water, determine the velocity with which the machine descends through a certain space, which may easily be done by observing the cylinder on the surface, which will stop on the weights striking the bottom, and comparing this velocity with the velocity his vessel may be going through the water at any time when he wishes to get soundings; for instance, suppose the machine to descend at the rate of eight miles *per* hour, and the vessel to be going at the rate of four, the horizontal or stay line in this case should be equal to half the perpendicular one, but should rather exceed, which is of little consequence. The reel may be used

separately

separately with a common sounding lead, or it may be used together with Fig. 1 for shallow soundings, but for deep soundings the reel will not answer so well, as it is not calculated or proper to be used with more than one weight. If intended to take the perpendicular length of line, run off the reel, when the other part of the machine may be used without the reel, with any number of weights; or two weights may be used with the reel, but the perpendicular in this case must be taken from the register only, without paying any respect to the length of line run off the reel.

Fig. 2, represents the rotator with another kind of register. This instrument is to be used in an horizontal direction, for ascertaining the progress of a vessel at sea. A A *a a*, is a rotator revolving apparatus, exactly the same as the one before described for the sounding machine, except that the regulators are set a little forwarder, to make the rotator revolve in every six feet eleven inches and six-tenths of an inch, so as to correspond with the register, whereas the above-described one revolves in every seven feet. It has likewise four stays, two of which, B, B, are shewn. They are secured from vane to vane by screws, so that they make the rotator very strong; but the rotator may be made either with or without them. *c, c, c, c*, four cane rods, (each rod being about seventeen inches long,) which connect the rotator and register together. The reason why I put the rotator so far from the register, is to prevent it from being affected by the eddy of the register-wake. I prefer cane rods to metal ones, on account of their being so much lighter, and of less tendency to bear the rotator from its horizontal position, which is of advantage in slow sailing of the vessel; the register falls nearly in a perpendicular direction, but the rotator still preserves its hori-

 zontal

zontal position, and, by the means of an universal joint, it communicates its revolutions to the register.

The advantage in applying the rotator as above stated is, that it avoids the friction, of turning a rope about 100 yards long, which would be necessary was the register kept on board the vessel. D, is an universal joint, which is screwed to a separate axis, as represented in Fig. 3. E, in that figure is a crank, which catches on an arm that is fast on the pivot of an endless screw F, so that both axes go round at the same time. The use of this axis is to take the weight and friction off the rotator of the endless screw, which will make it very durable to what it would be was the rotator on the same axis. And as the chief of the friction and wearing out is on the axis to which the rotator is fixed, I have made it with moveable bushes, so that the mariner may, by carrying more than one set of bushes and axes, replace them occasionally without the assistance of a mechanic. The above-mentioned endless screw acts on a wheel of twenty teeth, the axis of which has a pinion with six leaves, which acts in a wheel of forty-two teeth; the axis of which has a pinion of seven, and acts in a wheel of forty-four teeth; the axis of which has a pinion of six, and carries an index round a circle, which I graduate into twelve parts, each answering to the twelfth of a mile. The last-mentioned pinion acts in a wheel of sixty teeth, the axis of which likewise has a pinion of six, and carries an index the reverse way round a scale, graduated into twelve parts, each answering to a mile, and is marked from one to ten. The last pinion acts in a pinion of sixty teeth; the axis of which carries an index round a scale, which is graduated into ten parts, each answering to ten miles, and marked from 10 to 100 miles. The number of wheels and teeth may be varied, so as to register any desired distance.

Fig.

Fig. 4, is a back view of Fig. 2, on which is represented two yards G G, rising about two inches above the pillar plate, and terminating towards the points H H, between which there is a clear passage for the water. These guards at the same time prevent the register revolving; which always has a tendency, when in the water, to remain as here represented. The above machine or improved log is to be kept towing after the vessel at sea, except in altering the vessel's course, then it must be taken in for inspection. The length of the line by which the machine must be towed may be varied, for as it must always be cleared of the eddy of the vessel's wake, which extends much farther when she is going eight or ten knots than when she is going but five, so that the mariner may vary the line from twenty to fifty fathoms, which great length I think will be necessary in quick sailing.

Fig. 5, represents another way of using the rotator with a different kind of register for determining the rates of currents wherever a small boat may be anchored.

A, A, Fig. 6, is a kind of metal joints to rods about twelve inches long, which may be made use of when it is required to get the rate of an under current, and the point to which it sets the machine may be let down by rods of the above description in the water to any depth below the index B. The current then begins to operate on the register the same as the wind does on a vane; the rotator (which must be secured to the cane rod A A) then presents itself to the current, and begins to revolve. The above-mentioned index B must be held by a person in the boat to the north, or given point, which must be in a perpendicular line with the point marked on a plate at D; which plate is divided into thirty-two parts, answering to the points of the compass, and a space cut out

at every division, so as to admit a locking piece D, the rotator having revolved for a little time, lets go the locking piece, which falls into some one of the spaces on the divided plate C C, whichever way the current may have carried the register. The mariner letting the machine remain in the water a limited time, on drawing it up he must examine the register, and compare it with the time it has been in the water; by which means he is able to determine the rate of the current, and, by examining the points on which the register is locked, he is likewise enabled to judge of the course the under current is setting to, although the upper current may be running a different way. F, is an axis, which the regulator turns on. G, the friction roller. H, a balance for the register. L, an endless screw, which acts in a wheel of twenty teeth; the axis of which has a pinion of six, and acts in a wheel of forty-two teeth. On the axis of this wheel is fixed a hoop, which is moved or set by an index or circle S. When this index is set to S, lift out the locking piece at D, and the upper end of it will pass an opening in the hoop, at which time turn the index from S half a circle either way, which will prevent the locking piece from falling until such time as the wheels move the index back to S. The last-mentioned axis has a pinion of seven, and acts in a wheel of forty-four teeth, the axis of which has a pinion of six, and carries the index round a circle, which is graduated into twelve parts, each answering to the twelfth of a mile. The last mentioned pinion has a wheel of sixty teeth, and carries an index the reverse way round a circle every ten miles, and is marked from one to ten. Care should be taken in fixing the vanes on the tubes, so that when the rotator is immersed in the water it may lie in a horizontal position. The vanes, as fixed on the above-mentioned

mentioned tube, leave the but-end of it clear four inches and three quarters. The rotator being put together, should be fixed on its centres, so that it may move freely, and if the vanes should not prove of equal weight, the heaviest must be reduced till the rotator become poised; this will be an advantage to the rotator in very slow sailing.

The most essential parts of my improvements are as follows: first, in respect to the sounding machine, the chief object of which is to do away or lessen the errors arising from the old method of taking soundings, as the chief guide for the mariner by that method is to judge of the perpendicular depth by length of line out, which is very apt to deceive him a great deal, whereas, on the above principle, he is governed by the descent of the sounding weight only, without paying any respect whatever to the length of line except in case of using the reel.

My improvements in the rotators are the invention of the air tube and the method of adjusting or regulating it. A rotator on the above-mentioned principle will answer both for quick and slow sailing, and give the true distance, in both cases, without any danger of its breaking the register in quick sailing by holding too much water. These are advantages which no former rotator ever possessed, and that the mariners may be able to determine whether the rotator has met with any accident, I make a steel gauge, one end of which I fix in a dot nearly at the extremity of the vane, the other end reaches to the next vane. I make a mark on it, and so contrive the process until all the vanes are marked; and as they are fixtures, their marks always remain at the same distance from each other. If the rotator has not received

any

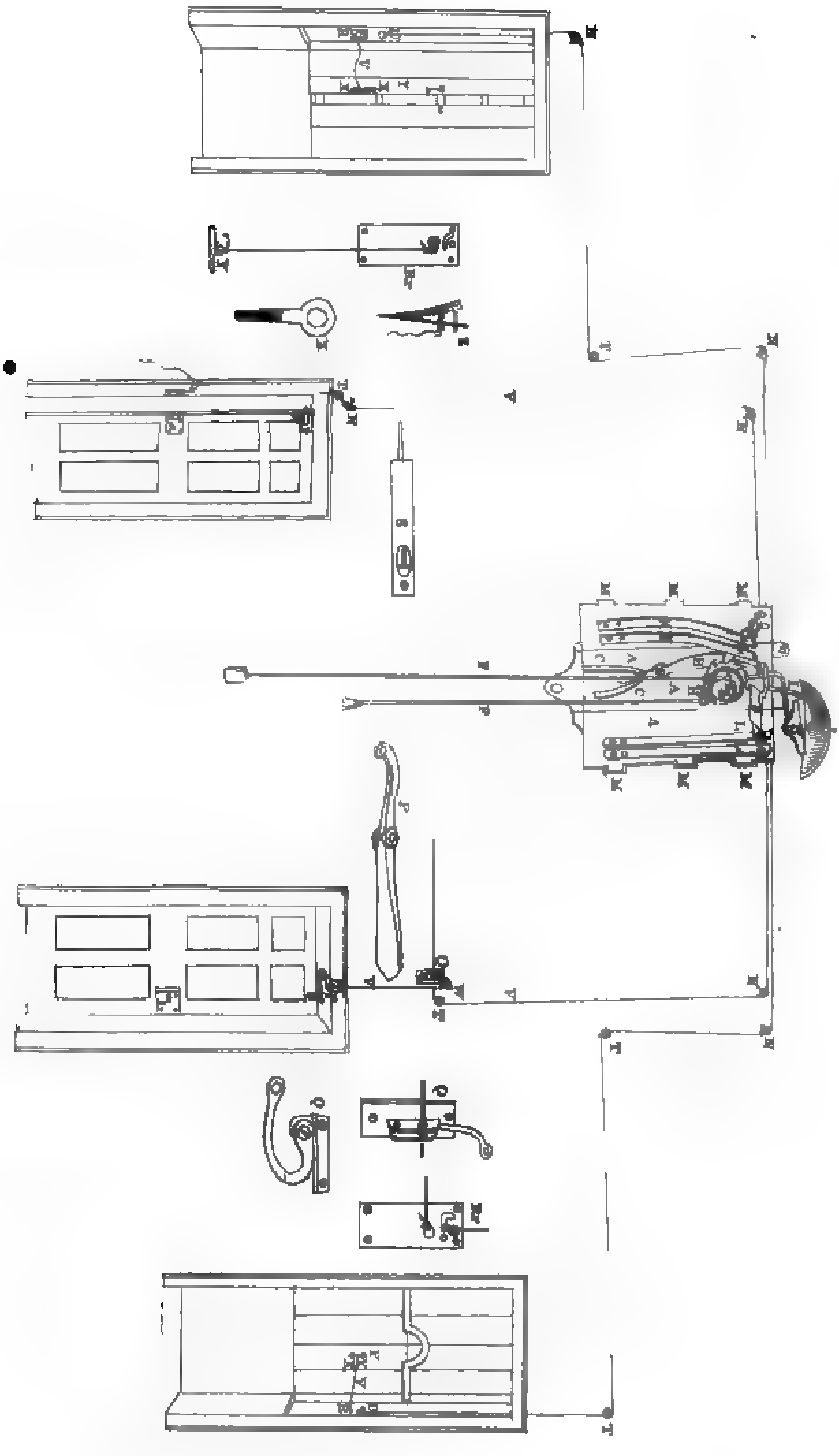
any injury, notwithstanding the rotary motion may be altered by the regulator as before described, the vanes still remaining stationary, so that the mariner may be assured whether the rotator has received any injury by applying the gauge as above stated. The registers may be made of brass, or any other fit materials.

In witness whereof, &c.

Specification of the Patent granted to Joseph Smith, *of Red Lion-street, Holborn, in the County of Middlesex, Smith; for a Mode of fixing and setting an Alarum, or Alarm Bell, so contrived as to alarm and awaken Families in case of Fire breaking out, or Thieves entering the House, by Night or Day.* Dated August 19, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Joseph Smith do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed; that is to say: The plan of the said alarum, or alarm bell, and the mode of its being fixed and set, is described and ascertained in and by a drawing at the top of these presents, intended to be enrolled herewith (see Plate IX). And the said alarum, or alarm bell being fixed at the upper or most distant part of a house, will be set going by any of the lines represented by letters V, V', (which are conducted to any part of the house,) either taking fire or being cut by the opening of the door, as at letter W or letter S, or the pin being removed to which it is affixed in the window or window-



window-shutter, as represented by letters X X and Y, as will be better explained and understood by the references to the said drawing, as follows.

References to the Drawing.

(See Plate IX.)

A A A, the interior case of the alarum.

B B, a self-acting stop.

C, C, two springs to adjust the stop.

D, a tooth-wheel.

E, a flat spring wheel.

F F, the line and weights affixed:

G, a centre spindle, on which a cap incloses D E.

H, H, a verge and hammer.

I, I, bell and carriage.

K, K, two springs, represent the alarm set going by the lines being burnt, cut, or let go.

L, L, two springs, representing the alarum set or stopped by the lines being fast.

M, M, M, M, M, M, rivets, to fix a front plate to inclose B B, C C, D, E, part of F F, G, K K, L L.

N N N N N N, a wheel crank, for conducting the wire or line.

P P, a centre lever, to be applied to doors or windows, as occasion may require.

Q, Q, Q, three-jointed cutters, to cut line to be affixed to doors or windows, which, on being forced or opened, cut the lines communicating with the springs K, K, or L, L, and let off the alarm.

R, R, R *r*, R *r*, spring catches, to be affixed to window-shutters, which on being moved let go the line or wire, and set the alarum going.

S, S, sliding cutters for doors, which cut the line on the doors being opened, and let off the alarum.

T, T,

T, T, T, T, T, pulley wheels, to conduct wire or lines from the springs K K, L L, to the various points of the alarum.

U, U, rings affixed to the spring catches R, R.

V, V, on the left hand of the drawing, represent the lines cut and slackened, and by that means the alarum set going. V, V, on the right hand, represent the lines as set or fixed in spring catches.

W W, the sliding cutter (as letter S), as affixed to doors; one on the left represents the line cut, the alarum going; the one on the right the line fixed to the alarum, and uncut.

X, X, X, X, X, eyes, fixed in shutters to receive a pin, as letter Y.

Y, Y, Y, pins to slip into eyes, as represented by letter X, to which is connected a line communicating to the catch or letters R, R.

From K K, L, L, are trained wires, and a prepared line to communicate, as occasion may require, to whatever room or office a fire may be likely to commence in; and on the line being burnt asunder, the alarum is immediately set going, as represented by K K. And to prevent burglaries, the line from the spring in the alarum is trained to doors, windows, and shutters, as above represented; so on their being opened or moved, as at V, on the left hand of the drawing, the alarum must inevitably go off.

Z, the section of the spring catch R *r*, R *r*.

And this I do declare to be the specification of my said invention, in pursuance of the proviso contained in the said patent. In witness whereof, &c.

Account

Account of some Experiments and Observations on the constituent Parts of certain astringent Vegetables, and on their Operations in Tanning.

(Concluded from Page 123.)

III. *Experiments and Observations on Catechu or Terra Japonica.*

THE extract called catechu is said to be obtained from the wood of a species of the Mimosa *, which is found abundantly in India, by decoction and subsequent evaporation.

There are two kinds of this extract; one is sent from Bombay, the other from Bengal; and they differ from each other more in their external appearance than in their chemical composition. The extract from Bombay is of an uniform texture, and of a red-brown tint, its specific gravity being generally about 1.39. The extract from Bengal is more friable, and less consistent; its colour is like that of chocolate externally, but, when broken, its fracture presents streaks of chocolate and of red-brown. Its specific gravity is about 1.28. Their tastes are precisely similar, being astringent, but leaving in the mouth a sensation of sweetness. They do not deliquesce, or apparently change, by exposure to the air.

The discovery of the tanning powers of catechu, is owing to the President of the Royal Society, who, concluding from its sensible properties that it contained tannin, furnished me, in December, 1801, with a quantity for chemical examination.

In my first experiments, I found that the solutions of catechu copiously precipitated gelatine, and speedily

* See Kerr. Medical Observations, vol. V. p. 155.

tanned skin; and, in consequence, I began a particular investigation of their properties.

The strongest infusions and decoctions of the two different kinds of catechu do not sensibly differ in their nature or in their composition. Their colour is deep red-brown, and they communicate this tinge to paper; they slightly redden litmus-paper; their taste is highly astringent, and they have no perceptible smell.

The strongest infusions that I could obtain from the two kinds of catechu, at 48° Fahrenheit, were of the same specific gravity, 1.057. But, by long decoction, I procured solutions of 1.102, which gave, by evaporation, more than $\frac{1}{6}$ of their weight of solid matter.

Five hundred grains of the strongest infusion of catechu from Bombay, furnished only 41 grains of solid matter; which, from analysis, appeared to consist of 34 grains of tannin, or matter precipitable by gelatine, and 7 grains that were chiefly a peculiar extractive matter, the properties of which will be hereafter described. The quantity of solid matter given by the strongest infusion of the Bengal catechu, was the same, and there was no sensible difference in its composition. Portions of these solid matters, when incinerated, left a residuum, which seemed to be calcareous; but it was too small in quantity to be accurately examined, and it could not have amounted to more than $\frac{1}{100}$ of their original weights.

The strongest infusions of catechu acted upon the acids and pure alkalis in a manner analogous to the infusion of galls. With the concentrated sulphuric and muriatic acids, they gave dense light fawn-coloured precipitates. With strong nitrous acid they effervesced; and lost their power of precipitating the solutions of isinglass, and the salts of iron. The pure alkalis entered into union with their

their tannin, so as to prevent it from being acted upon by gelatine.

When the solutions of lime, of strontia, or of barytes, were poured into the infusions, copious precipitates, of a shade of light brown, were formed; and the residual fluid assumed a paler tint of red, and was found to have lost its power of precipitating gelatine.

After lime had been boiled for some time with a portion of the infusion, it assumed a dull red colour. The liquor that passed from it through the filtre had only a faint tint of red, did not act upon gelatine, and seemed to contain only a very small portion of vegetable matter. Pure magnesia, when heated with the infusion, acted upon it in an analogous manner; the magnesia became light red, and the residual fluid had only a very slight tinge of that colour. With carbonate of magnesia, the infusion became deeper in colour, and lost its power of precipitating gelatine; though it still gave, with oxygenated sulphate of iron, a light olive precipitate.

The carbonates of potash, of soda, and of ammonia, in their concentrated solutions, produced only a slight degree of turbidness in the infusion of catechu: they communicated to them a darker colour, and deprived them of the power of acting upon gelatine; though this power was restored by the addition of an acid.

After the mixture of the solutions of carbonate of potash and the infusions had been exposed to the atmosphere for some hours, a brown crust was found to have formed upon its surface, and a slight precipitation had taken place.

The salts of alumine precipitated the infusions, but less copiously than they precipitate the infusion of galls. A similar effect was produced by nitrate of potash, sulphate

of magnesia, prussiate of potash, and many other n
salts.

The nitrate or acetite of lead, in concentrated solt
when poured into the infusion, produced in it a
light-brown precipitate, which gave to the fluid a
tinous appearance. After this effect, there was no
acid found in it; and both the tannin and the extra
matter seemed to have been carried down in union w
portion of the metallic salt.

The solution of muriate of tin acted upon the infi
of catechu in a manner similar to that in which it
upon the infusion of galls.

The least oxygenated sulphate of iron produce
change in the infusion. With the most oxygenated
phate it gave a dense black precipitate, which, when
fused upon paper, appeared rather more inclined to
than the precipitate from galls.

The infusions were precipitated by the solution o
bumen.

The precipitates by gelatine had all a pale tint of
brown, which became deeper when they were exp
to the air. The compound of gelatine and the ta
of the strongest infusions of catechu appeared, by esti
tion of the quantity of isinglass in the solutions used
their precipitation, to consist of about 41 parts of tan
and 59 of gelatine.

Of two pieces of calf-skin which weighed, when
132 grains each, and which had been prepared for
ning, one was immersed in a large quantity of the in
sion of catechu from Bengal, and the other in an e
portion of the infusion of that from Bombay. In less t
a month they were found converted into leather. W
freed from moisture, by long exposure in the sunshi
they were weighed. The first piece had gained about
grai

grains; and the second piece 35½ grains. The leather was of a much deeper colour than that tanned with galls, and on the upper surface was red-brown. It was not acted on by hot or cold water; and its apparent strength was the same as that of similar leather tanned in the usual manner.

In examining the remainder of the infusions of catechu, in which skin had been converted into leather, I found in them much less extractive matter than I had reason to expect, from the comparative analysis of equal portions of the unaltered infusions made by solutions of gelatine. At first I was inclined to suppose that the deficiency arose from the action of the atmosphere upon the extractive matter, by which a part of it was rendered insoluble. But, on considering that there had been very little precipitation in the process, I was led to adopt the supposition, that it had entered into union with the skin at the same time with the tannin; and this supposition was confirmed by new experiments.

Both kinds of catechu are almost wholly soluble in large quantities of water; and, to form a complete solution, about 18 ounces of water, at 52°, are required to 100 grains of extract. The residuum seldom amounts to $\frac{1}{14}$ of the original weight of the catechu; and in most cases it is found to consist chiefly of calcareous and aluminous earths, and of fine sand, which, by accident or design, had probably been mixed with the primitive infusion at the time of its evaporation.

A considerable portion of both kinds of catechu is soluble in alcohol; but after the action of alcohol upon it, a substance remains, of a gelatinous appearance, and a light-brown colour, which is soluble in water, and is analogous in its properties to gum or mucilage.

The

The peculiar extractive matter in the catechu, is less soluble in water than the tanning principle when a small quantity of water is used to a large qu of catechu, the quantity of tannin taken up, as a from the nature of the strongest infusion, is very greater than that of the extractive matter.

The extractive matter is much more soluble in water than in cold water; and when saturated so of catechu are made in boiling water, a consic quantity of extractive matter, in its pure state, falls as the liquor becomes cool.

The peculiar extractive matter of the catechu n likewise obtained, by repeatedly lixiviating the ca when in fine powder, till the fluids obtained cease t cipitate gelatine; the residual solid will then be fo be the substance in question.

The pure extractive matter, whether procured fr Bombay or Bengal catechu, is pale, with a faint ti red-brown. It has no perceptible smell; its taste is sl astringent; but it leaves in the mouth, for some ti sensation of sweetness, stronger than that given b catechu itself.

Its solution in water is at first yellow-brown; gains a tint of red by exposure to the air. Its solut alcohol does not materially change colour in the sphere; and it is of an uniform dull brown.

The extractive matter, whether solid or in sol was not found to produce any change of colour upo getable blues.

It became of a brighter colour by the action of t kalis; but it was not precipitated from its solution i ter by these bodies, nor by the alkaline earths.

The aqueous solution of it, when mixed with sol of nitrate of alumine and of muriate of tin, became s ly turbid.

To nitrate of lead it gave a dense light-brown precipitate.

It was not perceptibly acted upon by solution of gelatine; but when solution of sulphate of alumine was added to the mixture of the two fluids, a considerable quantity of solid matter, of a light-brown colour, was immediately deposited.

To the solution of oxygenated sulphate of iron it communicated a fine grass-green tint; and a green precipitate was deposited, which became black by exposure to the air.

It was not precipitated by the mineral acids.

Linen, by being boiled in the strongest solution of the extractive matter, acquired a light red-brown tint. The liquor became almost colourless; and, after this, produced very little change in the solution of oxygenated sulphate of iron.

Raw skin, prepared for tanning by being immersed in the strong solution, soon acquired the same kind of tint as the linen. It united itself to a part of the extractive matter; but it was not rendered by it insoluble in boiling water.

The solid extractive matter when exposed to heat softened, and became darker in its colour, but did not enter into fusion. At a temperature below that of ignition, it was decompounded. The volatile products of its decomposition were, carbonic acid, hydrocarbonate, and water holding in solution acetous acid and a little unaltered extractive matter. There remained a light and very porous charcoal.

In considering the manner in which the catechu is prepared, it would be reasonable to conclude, that different specimens of that substance must differ in some measure in their composition, even in their pure states; and, for the

the purposes of commerce, they are often adulterat a considerable extent with sand and earthy matter *.

In attempting to estimate the composition of the p catechu, I selected pieces from different specimens, which I was supplied by the president, and reduced together into powder; mixing, however, only pieces which were from catechu of the same kind.

Two hundred grains of the powder, procured i way, from the catechu of Bombay, afforded by anal

	G
Tannin	1
Peculiar extractive matter	
Mucilage	
Residual matter, chiefly sand and calcareous earth	

The powder of the Bengal catechu gave, by si methods of analysis, in 200 grains,

	G
Tannin	
Peculiar extractive matter	
Mucilage	
Residual matter, sand, with a small quantity of calcareous and aluminous earths	

In examining those parts of the catechu from B which were differently coloured, I found the largest portion of tannin in the darkest part of the subst and most extractive matter in the lightest part. probable that the inequality of composition in this chu is owing to its being evaporated and formed wi much agitation; in consequence of which, the consti

* One specimen that I examined, of the terra japonica of com furnished, by incineration, one-fifth of sand and earthy matte another specimen, nearly one-fixth.

parts of it that are least soluble, being first precipitated, appear in some measure distinct from the more soluble parts, which assume the solid form at a later period of the process.

From the observations of Mr. Kerr *, it would appear that the pale catechu is that most sought after in India; and it is evidently that which contains most extractive matter. The extractive matter seems to be the substance that gives to the catechu the peculiar sweetness of taste which follows the impression of astringency; and it is probably this sweetness of taste which renders it so agreeable to the Hindoos, for the purpose of chewing with the beetle-nut.

IV. *Experiments and Observations on the astringent Infusions of Barks, and other Vegetable Productions.*

The barks that I examined were furnished me by my friend Samuel Purkis, Esq. of Brentford; they had been collected in the proper season, and preserved with care.

In making the infusions, I employed the barks in coarse powder; and, to expedite the solution, a heat of from 100 to 120° Fahrenheit was applied.

The strongest infusions of the barks of the oak, of the Leicester willow, and of the Spanish chesnut, were nearly of the same specific gravity, 1.05. Their tastes were alike, and strongly astringent; they all reddened litmus-paper; the infusion of the Spanish chesnut-bark producing the highest tint, and that of the Leicester willow-bark the feeblest tint.

Two hundred grains of each of the infusions were submitted to evaporation; and in this process the infusion of the oak-bark furnished 17 grains of solid matter; that of the Leicester willow about 16½ grains; and that of the Spanish chesnut nearly an equal quantity.

* Medical Observations, vol. V. page 155.

The tannin given by these solid matters was, in from the oak-bark infusion, 14 grains; in that from willow-bark infusion $14\frac{1}{2}$ grains; and in that from Spanish chesnut-bark infusions 13 grains.

The residual substances of the infusions of the Span chesnut-bark, and of the oak-bark, slightly reddened mus-paper, and precipitated the solutions of tin of a fa colour, and those of iron black. The residual matter the infusion of the willow-bark did not perceptibly chan the colour of litmus; but it precipitated the salts of ir of an olive colour, and rendered turbid the solution nitrate of alumine.

The solid matters produced by the evaporation of th infusions gave, by incineration, only a very small quantity of ashes, which could not have been more than $\frac{1}{150}$ of their original weights. These ashes chiefly consisted of calcareous earth and alkali; and the quantity was greatest from the infusion of chesnut-bark.

The infusions were acted on by the acids and the pure alkalis in a manner very similar to the infusion of galls, With the solutions of carbonated alkalis they gave dense fawn-coloured precipitates. They were copiously precipitated by the solutions of lime, of strontia, and of barytes; and, by lime-water in excess, the infusions of oak and of chesnut bark seemed to be deprived of the whole of the vegetable matter they held in solution.

By being boiled for some time with alumine, lime, and magnesia, they became almost colourless, and lost their power of acting upon gelatine and the salts of iron. After being heated with carbonate of lime and carbonate of magnesia, they were found deeper coloured than before; and though they had lost their power of acting on gelatine, they still gave dense olive-coloured precipitates with the salts of iron.

In

In all these cases the earths gained tints of brown, more or less intense.

When the compound of the astringent principles of the infusion of oak-bark with lime, procured by means of lime-water, was acted on by sulphuric acid, a solution was obtained, which precipitated gelatine, and contained a portion of the vegetable principles, and a certain quantity of sulphate of lime; a solid fawn-coloured matter was likewise formed, which appeared to be sulphate of lime, united to a little tannin and extractive matter *.

The solutions were copiously precipitated by solution of albumen.

The precipitates they gave with gelatine were similar in their appearance; their colour at first was a light tinge of brown, but they became very dark by exposure to the air. Their composition was very nearly similar; and, judging from the experiments on the quantity of gelatine employed in forming them, the compound of tannin and gelatine from the strongest infusion of oak-bark, seems to consist in the 100 parts, of 59 parts of gelatine and 41 of tannin; that from the infusion of Leicester willow-bark, of 57 parts of gelatine and 43 of tannin; and that from the infusion of Spanish chesnut-bark, of 61 parts of gelatine and 39 of tannin.

Two pieces of calf-skin, which weighed when dry 120 grains each, were tanned; one in the strongest infusion of Leicester willow-bark, and the other in the strongest

* M. Merat Guillot proposes a method of procuring pure tannin, (published in the 16th vol. of the first series of this work, p. 89,) which consists in precipitating a solution of tan by lime-water, and decomposing it by nitric or muriatic acid. The solution of the solid matter obtained in this way in alcohol, he considers as a solution of pure tannin; but, from the experiments above mentioned, it appears that it must contain, besides tannin, some of the extractive matter of the bark; and it may likewise contain saline matter.

infusion of oak-bark. The process was completed, in both instances, in less than a fortnight; when the weight of the leather formed by the tannin of the Leicester willow-bark was found equal to 161 grains; and that of the leather formed by the infusion of oak-bark was equal to 164 grains.

When pieces of skin were suffered to remain in small quantities of the infusions of the oak-bark, and of the Leicester willow-bark, till they were exhausted of their tanning principle, it was found, that though the residual liquors gave olive-coloured precipitates with the solutions of sulphate of iron, yet they were scarcely rendered turbid by solutions of muriate of tin; and there is every reason to suppose that a portion of their extractive matter had been taken up with the tannin by the skin.

I attempted in different modes to obtain uncombined gallic acid from the solid matter produced by the evaporation of the barks, but without success. When portions of this solid matter were exposed to the degree of heat that is required for the production of gallic acid from Aleppo galls, no crystals were formed; and the fluid that came over gave only a brown colour to the solution of salts of iron, and was found to contain much acetous acid and empyreumatic oil.

When pure water was made to act, in successive portions, upon oak-bark in coarse powder, till all its soluble parts were taken up, the quantities of liquor last obtained, though they did not act much upon solution of gelatine, or perceptibly redden litmus-paper, produced a dense black with the solution of sulphate of iron: by evaporation they furnished a brown matter, of which a part was rendered insoluble in water by the action of the atmosphere; and the part soluble in water was not in any degree taken up by sulphuric ether; so that if it con-

tained

tained gallic acid, it was in a state of intimate union with extractive matter.

Two pieces of calf-skin, which weighed when dry 94 grains each, were slowly tanned; one by being exposed to a weak infusion of the Leicester willow-bark, and the other by being acted upon by a weak infusion of oak-bark. The process was completed in about three months; and it was found, that one piece of skin had gained in weight 14 grains, and the other piece about 16½ grains. This increase is proportionally much less than that which took place in the experiment on the process of quick tanning. The colour of the pieces of leather was deeper than that of the pieces which had been quickly tanned; and to judge, from the properties of the residual liquors, more of the extractive matters of the barks had been combined with them.

The experiments of Mr. Biggin * have shown, that similar barks, when taken from trees at different seasons, differ as to the quantities of tannin they contain: and I have observed, that the proportions of the astringent principles in barks vary considerably according as their age and size are different; besides, these proportions are often influenced by accidental circumstances, so that it is extremely difficult to ascertain their distinct relations to each other.

In every astringent bark, the interior white bark (that is, the part next to the alburnum) contains the largest quantity of tannin. The proportion of extractive matter is generally greatest in the middle or coloured part: but the epidermis seldom furnishes either tannin or extractive matter.

The white cortical layers are comparatively most abundant in young trees; and hence their barks contain,

* Published in the 12th vol. of the first series of this work, p. 25.

in

in the same weight, a larger proportion of tannin than the barks of old trees. In barks of the same kind, but of different ages, which have been cut at the same season; the similar parts contain always very nearly the same quantities of astringent principles; and the interior layers afford about equal portions of tannin.

An ounce of the white cortical layers of old oak-bark furnished, by lixiviation and subsequent evaporation, 108 grains of solid matter; and of this 72 grains were tannin: An equal quantity of the white cortical layers of young oak produced 111 grains of solid matter, of which 77 were precipitated by gelatine.

An ounce of the interior part of the bark of the Spanish chesnut, gave 89 grains of solid matter, containg 63 grains of tannin.

The same quantity of the same part of the bark of the Leicester willow, produced 117 grains, of which 79 were tannin.

An ounce of the coloured or external cortical layers from the oak, produced 43 grains of solid matter, of which 19 were tannin.

From the Spanish chesnut, 41 grains, of which 14 were tannin.

And, from the Leicestor willow, 34 grains, of which 16 were tannin.

In attempting to ascertain the relative quantities of tannin in the different *entire* barks, I selected those specimens which appeared similar with regard to the proportions of the external and internal layers, and which were about the average thickness of the barks commonly used in tannin, namely, half an inch.

Of these barks, the oak produced, in the quantity of an ounce, 61 grains of matter dissolved by water, of which 29 grains were tannin.

The

The Spanish chesnut 53 grains, of which 21 were tannin.

And the Leicester willow 71 grains, of which 33 were tannin.

The proportions of these quantities, in respect to the tanning principle, are not very different from those estimated in Mr. Biggin's table *.

The residual substances obtained in the different experiments, differed considerably in their properties; but certain portions of them were, in all instances, rendered insoluble during the process of evaporation. The residuum of the chesnut-bark, as in the instance of the strongest infusion, possessed slightly acid properties; but more than three-fourths of its weight consisted of extractive matter. All the residuums in solution, as in the other cases, were precipitated by muriate of tin; and, after this precipitation, the clear fluids acted much more feebly than before on the salts of iron; so that there is great reason for believing, that the power of astringent infusions to precipitate the salts of iron black, or dark coloured, depends partly upon the agency of the extractive matters they contain, as well as upon that of the tanning principle and gallic acid.

In pursuing the experiments upon the different astringent infusions, I examined the infusions of the bark of the elm and of the common willow. These infusions were acted on by reagents in a manner exactly similar to the infusions of the other barks: they were precipitated by the acids, by solutions of the alkaline earths, and of the carbonated alkalis; and they formed, with the caustic alkalis, fluids not precipitable by gelatine.

An ounce of the bark of the elm, furnished 13 grains of tannin.

* Published in the 12th vol. of the first series of this work, p. 30.

The

The same quantity of the bark of the common willow, gave 11 grains.

The residual matter of the bark of the elm, contained a considerable portion of mucilage; and that of the bark of the willow, a small quantity of bitter principle.

The strongest infusions of the sumachs from Sicily and Malaga, agree with the infusions of barks in most of their properties; but they differ from all the other astringent infusions that have been mentioned in one respect, they give dense precipitates with the caustic alkalis. Mr. Proust has shown, that sumach contains abundance of sulphate of lime; and it is probable to this substance that the peculiar effect is owing.

From an ounce of Sicilian sumach I obtained 165 grains of matter soluble in water, and of this matter 78 grains were tannin.

An ounce of Malaga sumach produced 156 grains of soluble matter, of which 79 appeared to be tannin.

The infusion of myrabolans * from the East Indies differed from the other astringent infusions chiefly by this circumstance, that it effervesced with the carbonated alkalis; and it gave with them a dense precipitate, that was almost immediately redissolved. After the tannin had been precipitated from it by gelatine, it strongly reddened litmus-paper, and gave a bright black with the solutions of iron. I expected to be able to procure gallic acid, by distillation, from the myrobalans: but in this I was mistaken; they furnished only a pale yellow fluid, which gave merely a slight olive tinge to solution of sulphate of iron.

Skin was speedily tanned in the infusion of the Myrobalans; and the appearance of the leather was similar to the appearance of that from galls.

* The Myrabolans used in these experiments are the fruit of the Terminalia Chebula. Retz. *Obs. Botan.* Fasc. V. p. 31.

The

The strongest infusions of the teas are very similar in their agencies upon chemical tests, to the infusions of catechu.

An ounce of Souchong tea produced 48 grains of tannin.

The same quantity of green tea gave 41 grains.

Dr. Maton has observed, that very little tannin is found in cinchona, or in the other barks supposed to be possessed of febrifuge properties. My experiments tend to confirm the observations. None of the infusions of the strongly bitter vegetable substances that I have examined give any precipitate to gelatine. And the infusions of quassia, of gentian, of hops, and of chamomile, are scarcely affected by muriate of tin; so that they likewise contain very little extractive matter.

In all substances possessed of the astringent taste there is great reason to suspect the presence of tannin; it even exists in substances which contain sugar and vegetable acids. I have found it in abundance in the juice of sloes; and my friend Mr. Poole, of Stowey, has detected it in port-wine.

V. *General Observations.*

Mr. Proust has supposed, in his paper upon tannin and its species *, that there exist different species of the tanning principle, possessed of different properties, and different powers of acting upon re-agents, but all precipitable by gelatine. This opinion is sufficiently conformable to the facts generally known concerning the nature of the substances which are produced in organised matter; but it cannot be considered as proved till the tannin in different vegetables has been examined in its pure or in-

* Published in the 1st. vol. of the second series of this work, p. 145.

there is no evidence which ought to induce us to suppose that it loses a portion of oxygen ; and the effect appears to be owing merely to the separation of the gelatine, from the small quantity of albumen with which it was combined in the organised form by the solvent powers of water.

The different qualities of leather made with the same kind of skin, seem to depend very much upon the different quantities of extractive matter it contains. The leather obtained by means of infusion of galls, is generally found harder, and more liable to crack, than the leather obtained from the infusions of barks ; and in all cases it contains a much larger proportion of tannin, and a smaller proportion of extractive matter.

When skin is very slowly tanned in weak solutions of the barks, or of catechu, it combines with a considerable proportion of extractive matter ; and in these cases, though the increase of weight of the skin is comparatively small, yet it is rendered perfectly insoluble in water ; and is found soft, and at the same time strong.

The saturated astringent infusions of barks contain much less extractive matter, in proportion to their tannin, than the weak infusions ; and when skin is quickly tanned in them, common experience shows that it produces leather less durable than the leather slowly formed.

Besides, in the case of quick tanning by means of infusions of barks, a quantity of vegetable extractive matter is lost to the manufacturer, which might have been made to enter into the composition of his leather. These observations show, that there is some foundation for the vulgar opinion of workmen, concerning what is technically called the *feeding* of leather in the slow method of

tanning ;

tanning; and though the processes of the art may in some cases be protracted for an unnecessary length of time, yet in general they appear to have arrived, in consequence of repeated practical experiments, at a degree of perfection which cannot be very far extended by means of any elucidations of theory that have as yet been made known.

On the first view it appears singular that, in those cases of tanning where extractive matter forms a certain portion of the leather, the increase of weight is less than when the skin is combined with pure tannin; but the fact is easily accounted for, when we consider that the attraction of skin for tannin must be probably weakened by its union with extractive matter; and whether we suppose that the tannin and extractive matter enter together into combination with the matter of skin, or unite with separate portions of it, still, in either ease, the primary attraction of tannin for skin must be, to a certain extent, diminished.

In examining astringent vegetables in relation to their powers of tanning skin, it is necessary to take into account not only the quantity they contain of the *substance* precipitable by gelatine, but likewise the quantity, and the nature, of the extractive matter; and, in cases of comparison, it is essential to employ infusions of the same degree of concentration.

It is evident, from the experiments detailed in the third section, that of all the astringent substances which have been as yet examined, catechu is that which contains the largest proportion of tannin; and in supposing, according to the common estimation, that from four to five pounds of common oak-bark are required to produce one pound of leather, it appears, from the various synthetical experiments,

periments, that about half a pound of catechu would answer the same purpose *.

Also, allowing for the difference of the composition of the different kinds of leather, it appears, from the general detail of facts, that one pound of catechu, for the common uses of the tanner, would be nearly equal in value to $2\frac{1}{4}$ pounds of galls, to $7\frac{1}{2}$ pounds of the bark of the Leicester willow, to 11 pounds of the bark of the Spanish chesnut, to 18 pounds of the bark of the elm, to 21 pounds of the bark of the common willow, and to 3 pounds of sumach.

Various menstruums have been proposed for the purpose of expediting and improving the process of tanning, and amongst them lime-water and the solutions of pearl-ash; but as these two substances form compounds with tannin which are not decomposable by gelatine; it follows that their effects must be highly pernicious; and there is very little reason to suppose, that any bodies will be found which, at the same time that they increase the solubility of tannin in water, will not likewise diminish its attraction for skin.

* This estimation agrees very well with the experiments lately made by Mr. Purkis, upon the tanning powers of Bombay catechu in the processes of manufacture, and which he has permitted me to mention. Mr. Purkis found, by the results of different accurate experiments, that one pound of catechu was equivalent to seven or eight of oak-bark.

On

On a new Method of cultivating weak Arable Lands,

By A. HUNTER, *M. D. F. R. S. L. and E.*

From GEORGICAL ESSAYS.

VARIOUS are the methods recommended by husbandmen for the cropping of their lands. Some employ themselves rationally in suiting the crops to the nature of the soil, while others follow the immemorial custom of the village. Farmers in general agree in this, that a fallow is necessary; but they differ as to the time of its rotation. In the scheme of agriculture, recommended by Virgil, there is no change of species. Wheat and fallow succeed each other. Collumella observes the same thing. This seems to have been the foundation of the drill and horse-hoeing husbandry; a scheme pursued with indefatigable diligence by Mr. Tull; but it requires so much nicety and attention, that I apprehend it never will be brought into general use. The principles, however, upon which it is founded ought to be understood by every farmer, as they will enable him to reason properly upon some of the most interesting operations of agriculture, and lead him insensibly to neatness in the management of his farm. I do not mean that he should adopt the theory of Mr. Tull. I would have him only reason upon his practice in regard to the destruction of weeds, and the loosening of the soil.

Reflecting, some years ago, upon the old and new husbandry, I thought that a system might be formed of a mixed nature, that would comprehend the advantages of both, without the inconveniences of either. I was the more desirous of reducing my reasoning into practice, as the

the plan seemed well adapted to the cultivation of weak arable lands that lie remote from manure.

I am sensible that, by the introduction of turnips and artificial grasses, these weak lands may be cultivated in the most profitable manner; but in wide-extended countries, without a hedge, these improvements cannot easily be introduced.

It will be almost unnecessary to observe, that arable lands have ever been restored by means of a fallow, which the judicious husbandman makes more or less frequent in proportion to the poverty of the soil. Upon the high Wolds in Yorkshire, where the soil is poor and thin, oats and barley are principally cultivated. The usual husbandry in open field-land is one crop and a fallow; and in some places, where there is a greater poverty of soil, they are content with a single crop, and then let the land rest for some years to recover itself.

These appear unsatisfactory modes of cultivation. A few straggling sheep, that browse upon the fallows, cannot restore to the earth what the weeds devour. Weeds and corn live upon the same food. To protect the latter, we must destroy the former. Wherever abundance of weeds are observed upon the fallows, we may pronounce the husbandry of the district to be feeble, the husbandman poor, and the rents low. To remedy the defective cultivation of weak arable lands, I have adopted the following system. My practice fully justifies the recommendation.

Instead of having the lands laid out in broad ridges, I order them to be made only nine feet wide. When the seed-time comes, I sow every other land broad-cast, and harrow in the grain in the usual manner. The intermediate spaces, which I call the fallow lands, are ploughed two or three times, at proper seasons, by a light plough drawn

drawn by one horse, in order to make a clean fallow for the succeeding crop. Upon these lands the seed is sown as before. The stubble in turn becomes the fallow, and is treated accordingly. In this alternate way I manage weak arable lands, and I have the satisfaction to find that very little manure is required, which is a most agreeable circumstance, as such lands are generally remote from a large town. I dare venture to say, that the same field, managed in this alternate way for a few years, will be found to produce one-third part more profit than when cultivated in the usual manner.

Farmers that have large tracts of weak arable land, and live remote from dung, will find this mode both profitable and easy of application. I do not recommend it where the lands are deep and rich, or within a reasonable distance of manure.

To account for the advantages of this culture, we need only reflect that vegetables, no more than animals, can subsist long in a state of health without the free enjoyment of air. In a large field, when the weather is calm, the air remains in a state of stagnation, whereby the perspiration of the plants is permitted to continue too long upon the ears of corn. Hence many inconveniences arise to the crop. On the contrary, in the alternate husbandry, the air is constantly in motion. The intermediate fallows serve as funnels to carry it off, and along with it all superfluous moisture.

In consequence of this freedom of air, upon which I lay a great stress, the ears of corn are always observed to be well fed, and the stalks firm and strong. When by severe weather the corn happens to be lodged, it is thrown upon a clean fallow, where it has no chance of being bound down by weeds. It is consequently sooner

raised by the current of air which is constantly passing along the fallows.

It is, however, the particular happiness of this method of cultivation, that the corn is seldom laid, even in the most stormy weather.

Turnips, or, when the soil is deep and sandy, a few carrots or potatoes may be placed upon the intermediate lands: but I have always found it best to keep them as perfect fallows. Every thing that grows takes something from the soil; and as our land is supposed to be weak, and not supported with much manure, we ought not to suffer the smallest vegetable to take root upon it.

If the farmer chooses he may vary his crops; but I am of opinion, and I speak from some experience, that the same grain may be cultivated, as long as he pleases, upon lands managed in the manner that I have recommended. In consequence of this happy disposition of the soil, every kind of grain may be suited to the land most proper for it. I do not confine the alternate husbandry to oats, barley, and rye. I have tried it upon good wheat land; and if the farmer attends to his business, he will find his wheat crops greatly to exceed his expectations. In the cultivation of this grain the utmost attention must be paid to the cleanliness of the fallow lands. For want of proper care in that particular, I was once very unsuccessful in an experiment of two acres.

In October, 1769, I began an extensive trial with wheat upon good land, and as I was desirous of making two experiments at the same time, I manured the sown lands with the oil-compost, at the rate of 9*s.* *per* acre, which, though an annual charge, may be considered as a trifling sum. At present *(February)* the field looks well, and promises a plentiful crop. I shall minutely attend to every

every particular, that I may be able to communicate the experiment upon a future occasion.

I acknowledge that many of the advantages of this culture are in common with the drill husbandry; but I flatter myself that there are others which that ingenious system does not enjoy.

I know it will be objected, that in this manner the fallows will be lost to the sheep during the summer months. I answer, so much the better. If possible, the fallows should not be permitted to bear a single leaf. The farmer ought to find other ways to support his sheep; and if he is an intelligent man, he will readily do it. It is an odd kind of husbandry, when the fields bear corn one year for the owner, and the next weeds for his sheep.

When first I practised this new culture, I was apprehensive that the pigeons and crows would prove my greatest enemies, by settling upon the fallow lands, and pulling down the ears of corn. I have now the pleasure to assure the public, that, after some years experience, I find my lands no more liable to those depredations than the neighbouring ones.

I need not observe, that by this system of husbandry the lands are rendered open and light. In consequence of which, abundance of nourishment will be conveyed into the body of the soil, instead of being left upon the surface, to be exhaled by the sun, or swept off by the winds. But as the best things sometimes bring inconveniencies with them, it will be necessary to correct this looseness of the soil by rolling the lands at proper seasons. For this the husbandman needs no directions.

I have the satisfaction to find that inclosures are begun upon the Lincolnshire and Yorkshire Wolds; in consequence of which, a greater quantity of corn will be pro-

duced for a few years than formerly. To such gentlemen as have estates in those counties, or in similar ones, I beg leave to recommend the alternate husbandry. I dare venture to say, that, in point of profit and convenience, it will be found greatly superior to the drill husbandry. The implements used are those of the country, and the mode of cultivation is within the capacity of the meanest ploughman.

Method of making a rich Compost of Pond Mud, &c.

By Mr. WILLIAM SPEECHLY.

From GEORGICAL ESSAYS.

WE may naturally suppose that the mud of ponds in general is of a rich nature, when we consider the materials of which it is composed. First. Ponds, from the lowness of their situation, receive the drainage, and consequently the riches of the adjacent lands around them. Secondly. A supply of various matter is constantly brought by the wind, and particularly the leaves of trees during the winter season. Lastly. Cattle afford the greatest supply by their dung and urine, as they frequent ponds at most seasons, but chiefly in warm weather.

Let the pond be cleaned out any time during the summer; if the mud is soft and slimy when taken out, it will be proper to let it lie a short time near the pond bank to harden: then mark out a staddle, in proportion to the quantity of mud taken out, which if not very considerable, the first course, or foundation, of the intended heap, may be made of common mould, taken from any

mound,

mound, hillock, &c. where it is most convenient, which should be laid at least one foot thick; upon this lay a course of dung, fresh from the stable, fourteen or fifteen inches in thickness; next put a layer of pond-mud, nine or ten inches thick, upon which lay a course of lime, fresh from the kiln, five or six inches thick; and so alternately a layer of dung and lime between every two layers of pond-mud till the whole is finished. In this place it should be remarked, that it is absolutely necessary to separate the layers of lime and dung by a layer of pond mud.

In places where they can be got, the offal of animals, soot, sawdust, sweepings of streets, or in short any vegetable or animal substance that is reducible, will be exceedingly proper to add to the compost. The whole may be covered with a coat of common mould. The dung and lime will occasion a gentle ferment throughout the whole mass, the bottom layer excepted.

After the heap has lain three or four months, it should be turned over with the spade, and by the next spring it will be ready to lay upon tillage land; but if it is intended to be used as a top dressing, it should then continue in the heap till the following winter, by which time it will become a fine rich compost, exceedingly proper for that purpose. — In the latter instance, a good crop of potatoes may be got upon the heap, and it will save expense and trouble in weeding.

The quantity of mould in the bottom layer, and also in the covering, may be varied at pleasure.

Method

Method of making excellent Butter from the Milk of Cows fed upon Turnips. By C. CROWE, *Esq. of Kipling.*

FROM GEORGICAL ESSAYS.

LET the bowls, either lead or wood, be kept constantly clean, and well scalded with boiling water before using. When the milk is brought into the dairy, to every eight quarts mix one quart of boiling water; then put up the milk into the bowls to stand for cream. By keeping strictly to this method, I have constantly, during the winter, sweet and well-tasted butter from the milk of cows fed upon turnips. My cows are kept in the house at nights to hay, and are turned out in the day-time to turnips without waste.

Description of a Stopper for the Openings by which the Sewers of Cities receive the Water of their Drains.

By Mr. JOHN FRASER, *of Chelsea, London.*

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

THE parts of this stopper resemble so much the hopper and shoe of a grist-mill, that they may be called by those names. The opening by which the water from the drains passes down into the common sewer is generally secured at its orifice by a curb or frame of wood, and by an iron grating, which prevents large bodies from falling in. Let the iron grating open on a hinge, then set into the curb a hopper of wood, sheet or cast iron, so closely fitted at its

its top to the curb as to prevent the passage of air between them. Under this hopper suspend a shoe or box, close, except at top, within which the lower opening of the hopper may empty itself, and the water flow off over the brim of the shoe into the sewer. When the water ceases to flow, the shoe remaining full, keeps the lower opening of the hopper closed, so that no air can pass up through it. The iron grating is shut down on the hopper, to keep bodies from falling into it.

In Charleston and Savannah, where the streets are not paved, and are very sandy, such quantities of sand are carried by currents of air down through the drain-holes into the sewer, as to choke that entirely. To prevent this, lay a lid on the hopper, fitted to it, and having an aperture in its centre of half its own diameter. Under this aperture, and very near to it, and consequently within the hopper, suspend a pan, or other vessel, somewhat larger than the aperture, but less than the lid itself. The sand conveyed by the wind will fall through the aperture of the lid into the pan, and will soon fill it, and close the aperture, so that all the sand which follows will blow over and pass off. When it becomes necessary that the aperture should be re-opened to let the water of the drains pass through, that water will itself very quickly work its own way through the sand in the pan, wash it over the brim, and down through the hopper and shoe into the sewer, and restore the water passage; and thus the wind and water will alternately perform the functions of closing the passage against sand, or opening it for water as shall be necessary.

Memoir

Memoir on the various Alterations produced in Muriates of Mercury by the Action of different Bodies.

(Concluded from Page 155.)

Action of entire Vegetables.

EXPERIMENT I. Into a saturated cold solution of super-oxygenated muriate of mercury I plunged a fresh root of *lapathum silvestre* after being well washed. It was cut at one end, that the salt might easily penetrate it; the whole was exposed to an atmospheric temperature of 15 to 20 degrees, and an apparatus to collect the gas was adjusted to it. A few air bubbles were disengaged from the root. In twenty-four hours the bottom of the vessel containing the solution, and likewise the surface of the root, began to be covered with a greyish deposit so light as to be suspended in the liquid when slightly agitated. In ten days no elastic fluid was disengaged, the root was taken out of the solution, and left exposed to the air: it became dry in a few hours, and was very hard, brittle, and covered with a whitish efflorescence insoluble in water.

The liquor was impregnated with the smell of the root at the time of immersion; it reddened tincture of turnsol, and still contained a considerable quantity of corrosive sublimate.

The deposit when dried was coloured by a vegetable matter; but this colour was easily removed by cold nitric acid. There then remained an almost white powder, which I found to be very pure muriate of mild mercury.

Experiment II. The same experiment was performed with fresh stalks of the *solanum scandens*; it afforded the same

same results, excepting that the liquor was but slightly coloured, and the deposit less considerable.

Action of Gum.

Experiment I. A cold solution of the purest gum-arabic mixed with a solution of corrosive sublimate had undergone no perceptible alteration excepting that in twenty-four hours it lost its transparency.

The same solution gradually heated on a sand-bath to ebullition, and kept in that state for a quarter of an hour, deposited a light matter, being a mixture of a very small quantity of mild mercury and altered gum.

Experiment II. Gum arabic, incorporated with a sufficient quantity of water, saturated with corrosive sublimate, and exposed to a powerful heat in a luted glass retort, yielded the ordinary products of this principle immediately by fire, more muriatic acid and liquid mercury.

Action of Sugar.

The crystals of the finest sugar, treated in the same manner as the gum, afforded results not apparently different from that substance.

Action of Extracts.

Although the decomposition of corrosive sublimate by extractive matters appears to be a natural deduction from the theory of the action of metallic salts on those substances; although the decomposition of this salt, long since announced by M. Berthollet, in the decoction of quinquina, appears to belong to the same phenomenon; and, finally, although I have myself announced that decomposition by decoctions and extracts in general, yet the subject appeared to me sufficiently important to merit a more ample examination in order to remove every doubt on the result of that decomposition.

 Experi-

Experiment I. After having convinced myself of the identity of the action of extracts in general on corrosive sublimate; I selected that of the *solanum scandens* produced by maceration of the stalks of that plant in pure water. The extract obtained was completely soluble in cold water; I took 24 grammes of corrosive sublimate, prepared in the same manner as that used in all the foregoing experiments; I mixed it in a glass mortar, with 48 grammes of the above extract. The two substances formed a paste, which I left for two months at an atmospheric temperature of 15 to 18 degrees of the centigrade thermometer. It soon acquired a dusky yellow colour, which it preserved to the last. At the end of two months I diluted this mass, which had become almost solid, with about a litre of cold distilled water. The liquor became perfectly clear, and highly coloured; at the end of twenty-four hours, an abundant greyish deposit was formed. The liquor was drawn off by means of a syphon, put aside, and marked No. 1. The deposit was levigated with a fresh quantity of distilled water, equal to the former, which was in like manner drawn off at the end of twenty-four hours, preserved and marked No. 2. The deposit when dry weighed 16 grammes; it was greyish, and had a bitter taste.

Distilled water and alkohol boiled with this matter acquired a reddish colour, from the portion of oxygen which they took from it, and reduced it to 13 grammes; the remainder of the deposit, which was almost white, insoluble in cold mineral acids, soluble in warm nitric acid, and which, upon being exposed in a phial to the heat of a sand-bath, was entirely sublimated into very pure, mild muriate of mercury.

Examination

Examination of the Liquors.

The liquor No. 1, brown and very transparent, was disturbed by alkalis and lime, and turned black by sulphureted hydrogen: it whitened a piece of copper that remained in it for some time, and contained soluble muriate of mercury, the quantity of which it was difficult to ascertain. It furnished, by evaporation, a great quantity of extractive matter.

That marked No. 2 was of the colour of beer: it formed no precipitate with any of the re-agents which had been tried upon the first, to prove the presence of the mercurial salt. Acetite of lead rendered it extremely turbid.

Experiment II. A like mixture of 24 grammes of soluble muriate of mercury, and 48 of the same extract, were placed on a balnea mariæ, at a temperature lower than that of boiling water. Care was taken to add frequently a small quantity of distilled water, to prevent the desiccation of the matter. It was kept two hours in this state, and at the end of that time the mass resembled that which had been submitted to the slow action in the first experiment. Vapours of muriatic acid * were disengaged, which were known by their smell, and the application of ammoniac. It was then diluted in a litre of distilled water, and left to settle; and afterwards this extremely clear and highly coloured liquor being poured off from the deposit, was exposed to the heat of boiling water for an hour: and this was repeated several times till there ceased to be any deposit. The liquor being then ex-

* The disengagement of muriatic acid occasioned in this operation by the heat of the balnea mariæ necessarily took place, but in an imperceptible manner in that performed cold, since the result of both was the same.

 amined,

amined, contained no more corrosive sublimate. The deposits were collected, washed, and dried, and weighed 27 grammes. Acetous acid was boiled with it till it ceased to be coloured. The mass was then dried, and found to be mild, and almost pure mercury, weighing 20 or 21 grammes.

The loss in this instance was likewise owing to the oxygen absorbed by the extract, and to the muriatic acid, which was disengaged.

Experiment III. Equal parts of extract and oxygenated muriate of mercury mixed together, and distilled on a common fire, in a suitable apparatus, yielded the following products: pyro-acetous acid, empyreumatic oil, a small quantity of muriate of ammonia, abundance of muriatic acid, liquid mereury, carbonic acid, carbonated hydrogen gas, and, as a residue, a very light coal.

This result agrees with that of charcoal and the same salt. Hydrogen may nevertheless have contributed to this decomposition in order to form water, since it likewise takes place in primitive substances abounding wiђh hydrogen.

Action of fixed Oils.

Olive oil, mixed with an equal quantity of aqueous solution of the same salt, very soon becomes colourless if care is not taken to multiply the reciprocal contacts by agitation. By boiling the mixture for some time, the oil is turned quite white without being much thickened. In this case a small quantity of simple muriate is precipitated.

Action of volatile Oil dissolved in Alkohol.

Alkohol holding in solution volatile oils, and likewise that kind of solid volatile oil, known by the name of camphor,

camphor, act with corrosive sublimate in a manner very similar to the distilled waters of aromatic plants.

Experiment I. One gramme of corrosive sublimate was dissolved in 25 grammes of Cologne water. The liquor which was very transparent at the moment of mixing it, in twenty-four hours deposited a white powder, which was considerably augmented in a few days. This deposit was mild mercury mixed with a portion of essential oil, which by desiccation acquired a blackish colour. The liquor likewise contained corrosive sublimate unaltered.

Experiment II. The same experiment was made with wound balsam, with similar effect, only the deposit was less considerable.

Experiment III. Alkohol, saturated with camphor, cold, was mixed with a like solution of corrosive sublimate. The liquor, which was clear at the time of mixing it, became turbid in a few hours, and formed a deposit like the preceding.

N. B. It must be observed, that decomposition would have taken place in pure alkohol, but less slowly and perceptibly than in the preceding experiments.

Action of Resins.

Experiment. A mixture of alkoholic tincture of Gayac and an alkoholic solution of muriatic salt of mercury, yielded in twenty-four hours a deposit of mild mercury, charged with a resinous matter.

Conclusion.

From all the facts stated in this memoir, it results:

1. That corrosive sublimate is always more or less completely decomposed, and brought to the state of mild mercury, at the temperature of the atmosphere, by its contact

contact with light, charcoal, gum, sugar, extract, green plants, distilled waters of plants, alkohol, aromatic alkohols, fixed oils, resins, &c.

2. That this salt, the state of which is so easily changed by different substances, approaches the nearer to complete decomposition in proportion as it is promoted by the action of heat.

3. That in many cases where the decomposition was partial when cold, it is probable that by an addition to the quantity it would have been rendered more complete.

4. That at a high temperature it is decomposed, and reduced to its distinct principles by phosphorus, charcoal, and all other substances, the constituent principle of which is carbon.

5. That distilled water, gum, and sugar, being bodies which have very little action on corrosive sublimate, (probably in the case of the two latter, on account of their little analogy with the state of charcoal,) it is prudent to combine that salt only with those substances when it is employed as a medicine: it is also necessary to secure them from contact with light.

6. That nitric acid, by the aid of heat, dissolves this oxygenated muriate without altering it.

7. That a hot solution of mild mercury in nitric acid produces corrosive sublimate.

On

On the best Method of preparing gummy Extract of Opium. By M. LEROUX, *Apothecary of Paris.*

From the ANNALES DE CHIMIE.

OF all the processes hitherto published for the preparation of the gummy extract of opium, it may be with truth asserted, that none is exempt from inconvenience, or tends directly to the object that ought to be kept in view.

It is surprising that a medicine of such importance has not excited more emulation among apothecaries, anxious to give their compositions that degree of perfection and strength which are to be derived only from judicious observation and long experience.

This extract being one of those whose salutary effect depends enirely upon the state of perfection in which it is given to the patient, it is of importance that its mode of preparation should be uniform and invariable, that the physician who prescribes it may be enabled to rely on the efficacy of so useful a remedy, but which may prove prejudicial and dangerous if not entirely freed from the virulent particles of which it is intended to be deprived. From the different methods of preparing extract of opium results a composition, on whose effect the person who prescribes it can never depend, and more or less expensive to the apothecary who makes it. Each prefers the process which he imagines most advantageous, through indifference each follows that peculiar to himself, or which he is persuaded is the best, or, what is more common, private interest diverts the attention from the general welfare of society.

The

The method which I employ is known but to very few, and is subject to modifications depending on the judgment of the artist. It deserves to be generally adopted, on account of the expedition and facility with which an operation, rendered tedious and expensive by the formulæ of the dispensatories, may be performed. It is from this motive that I publish my process, persuaded that it combines all the conditions necessary for obtaining the extract of opium at the maximum of the virtues it ought to possess; but, before I proceed to the subject, it may not be amiss to take a rapid survey of the most common methods, and to indulge in a few observations upon them.

In Baumé's process, the length of the operation is one of the most powerful obstacles to be removed; the solution of opium cold would undoubtedly be a considerable improvement. That of Josse, as Baumé and Rosne have very justly remarked, appears better at first sight, but is not without inconveniences. To their observations it may be added, that it is very fatiguing to knead a certain quantity of opium for a length of time, and in every operation as much labour should be spared as possible. The method announced as superior to the others, and which consists in dissolving five or six times in water the extract obtained by filtering the liquor each time, is far from being infallible; it still contains resin after a great number of purifications. The trituration of opium, cold, which by many apothecaries is considered sufficient, constitutes a part of Josse's process; and, lastly, the directions furnished by Derosne, in his memoir on this substance, do not appear to me capable of producing the gummy extract of opium in its highest degree of purity. I therefore propose to substitute in their stead the following process.

Cut

Cut into pieces the opium of the shops, (the qualities of which should be previously ascertained,) and extract from it, by luke-warm water, all that liquid is capable of dissolving. When the opium is exhausted, put all the liquors together, in order to clarify them with white of eggs; strain the whole through a flannel till the liquor runs clear, and bring it, by evaporation, to the consistence of a soft extract. When reduced to this state, add to it alkohol of 30 or 32 degrees, in sufficient quantity to dissolve it; then precipitate the resin, by a sufficient quantity of water, and let it stand some hours; at the expiration of which time, strain it again through a flannel, to separate the resin; evaporate the liquid a second time, and re-dissolve the extract in fresh alkohol; precipitate it again with water as before; lastly, filtre the extract, and evaporate to the consistence required. By this method extract of opium may be obtained as pure as that prepared by long digestion. A pound of opium yields five or six ounces of extract, which is equal to the quantity which Baumé procured by his method.

As nothing ought to be neglected that may tend to diminish the price of the production in works on a large scale, the liquor with which the resin has been precipitated may be distilled in the balnea mariæ, for the purpose of collecting the alkohol, which may be used in future operations of this nature.

Preparation of a Luting, adapted to all the Operations of Chemistry in which it is necessary to be employed.

By M. PAYSSE, *Professor of Chemistry.*

From the ANNALES DE CHIMIE.

IT is now generally agreed, that the rapid progress made in chemistry within the last twenty years is partly owing to the various apparatus invented by the immortal Lavoisier, and to the additional precautions that have been adopted in the art of luting them. Luting has rendered essential services to chemistry; for, by facilitating the condensation of many aëriform products, it has furnished the means of determining their nature, and of ascertaining their quantity and weight. This truth has not escaped the sagacity of a justly celebrated chemist, M. Chaptal, who expresses himself in these terms: "It is on the art of properly luting an apparatus that the whole success of an operation depends."

Among the substances most commonly used for this purpose are, the greasy luting, paste of almonds, or linseed, from which the oil has been expressed, which is mixed with glue; that made of white of eggs and of soft cheese mixed with lime. The use of these different kinds is attended with inconveniences which render them improper to be employed in all circumstances. The greasy luting, for instance, composed of dried clay and oil combined with an oxyd of lead, can only be applied on such parts as are not exposed to too violent a degree of heat; they melt with a high temperature, run, and become of course quite unfit for the purpose for which they were intended. Those made with linseed and almonds, mixed with glue or gelatine, are frequently too

porous,

porous, easily destroyed by acids, and by ammoniac reduced to a gaseous state. The only inconvenience attending those prepared from white of egg and cream-cheese, mixed with lime, is, that they become solid so soon after they are incorporated that it is extremely difficult to lay them on.

The necessity I was under, when preparing a great quantity of oxygenated muriatic acid, of finding a luting, at the same time cheap, easy of preparation, capable of resisting the destructive action of the vapours of that acid, and likewise the powerful degree of heat to which the luted part was frequently exposed, that might be easily and uniformly applied without hardening too quickly, obliged me to make some investigations that were attended with the most satisfactory results.

After making a great number of mixtures with different substances, I found that the following method furnished a homogeneous composition, which, drying very slowly, acquired excessive hardness, was perfectly compact, and, in short, possessed all the properties that I wished.

Take white of eggs, together with the yolks, carbonated lime pulverized, or lime well slaked in the air, about half the weight of the eggs, apply it to a linen cloth, and lute with it.

This luting, the composition of which is so extremely simple, possesses a certain elasticity when dry. I have even formed vessels of it impermeable to water, and capable of being highly polished.

Observations on the Plant called St. John's Wort.

By M. BAUNACH, *Apothecary.*

From the ANNALES DE CHIMIE.

THIS plant is very well known, and grows in great abundance in the fields, the woods, and uncultivated spots. Botanists have given a description of its distinguishing characteristics under the name of *Hypericum perforatum:* it is employed in medicine as an excellent vulnerary and balsamic remedy, but dyers are still ignorant of the advantages which their art might derive from its juice. It is a resinous plant, whose flowers contain seed filled with a juice soluble in water, alkohol and vinegar; in the two former liquids it yields a colour like blood, and, in the latter, that of the most beautiful and brightest crimson. When combined with acids or metallic solutions, it affords a fine yellow colour, which proves that it contains two distinct colouring matters, one more soluble than the other.

To dye linen and woollen cloth, silk and cotton, yellow, it is sufficient to plunge them into liquor pretty strongly impregnated with the juice of this plant, and mixed with a certain quantity of mordant. The salt best suited for a mordant for this colour is sulphate of alumine, mixed with a proportionate quantity of carbonate of potash. The stuffs must be immersed in it some time, as the solidity of the colour depends upon that circumstance; upon the quantity of the mordant, and the degree of heat employed. When but little mordant is used, the colour is of a light yellow; by augmenting the quantity it becomes

comes darker; and by the addition of solution of tin in nitro-muriatic acid, it acquires rose, cherry, and crimson colours, of the most beautiful appearance. Alum, which is universally employed in all extractive dyes, is not proper for the present process: the addition of pot-ash is absolutely necessary, because it decomposes that salt, precipitates the earth from it, dissolves a considerable portion; and it is this alkaline salt, with an earthy basis, that becomes the actual mordant in this operation; as the colouring principle exists in a matter almost purely resinous.

The juice of St. John's wort, combined with the above-mentioned mordant, gives a beautiful yellow colour to paper; and as it produces the same effect upon leather, the tanners may employ it with advantage in staining white sheep-skins, &c.

This plant also contains much tanning matter, of which I have been convinced by experiments made with a solution of common glue in water, and with other substances.

By pouring into the juice a small quantity of solution of sulphate of iron, a blackish brown precipitate was formed, which possesses the property of absorbing oxygen, of becoming, in time, insoluble in water, and of assuming the characters of concrete resin.

St. John's wort contains no essential oil: having subjected a certain quantity of this plant to distillation with water, the produce of the liquid had a strong and agreeable smell; but in which I could perceive nothing analogous to volatile oil.

The juice of St. John's wort dissolves neither in greasy nor in volatile oils; but it unites perfectly with resins. To produce this effect, after expressing it from the plant, it

must

must be poured into a China plate for desiccation; which operation may be performed by placing it in an oven for some time, after the bread has been taken out, and then reducing it to powder. In this state it may be mixed with the turpentine: the solution is easily brought about by putting it into a copper mortar previously heated. The resin thus saturated with the juice, may be mixed with greasy or volatile oils: when combined with that of olives, it composes the medicine known by the name of Oil of Hypericum, which, when prepared in this manner, possesses very powerful virtues. If it be incorporated with linseed-oil, mixed with a small quantity of oil of turpentine, it produces a beautiful red varnish, which may be employed with advantage for varnishing furniture made of wood.

It is certain that St. John's wort is a resinous extractive substance, in which the resin predominates considerably; which is sufficiently proved by the phenomena of its solution in water, alkohol, resin, and particularly its inflammability, which is so great, that when placed upon ignited charcoal, it burns like incense, and emits very little smoke. It possesses the property of absorbing the atmospheric oxygen; it experiences no alteration from the air; its taste is rather bitter, and slightly astringent,

Transactions of Societies for promoting useful Knowledge.

France.

The Galvanic Society of Paris.

THE labours of this Society are continued with great zeal, and equal success.

New experiments have been made by professor Aldini, on the existence of a Galvanic atmosphere, and on the contractibility of the heart.

M. Nauche, with his assistants Bonet and Pajot Laforet, has made experiments on the brain and spinal marrow of an ox immediately after death. They succeeded in conducting the metallic fluid from them, by means of two metallic conductors, into the thighs of a frog, in which it produced muscular contractions. The same operation succeeded with palpitating muscles, but it would not take place a quarter of an hour after death.

M. Lamartillier has explained the cause of the disengagement of mucus at one of the extremities of the pile, and proved that it is occasioned by a chemical decomposition.

M. Paraisse has observed, that the diaphragm is one of the muscles which preserve the highest Galvanic irritability.

M. Izarn described the construction of a pile invented by M. Alizeau; in which, instead of the roundels impregnated with a saline solution, damp salt is employed, and which is capable of producing the Galvanic fluid for a month without being renewed.

The commission for the application of Galvanism to medical purposes has made a great number of experiments on asphyxia by strangulation.

Intelligence

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Patent for Brewing-Coppers voidable.

HARE *v.* HARFORD and TAYLOR.

ON the 14th of July, 1803, a cause was tried at the Guildhall of the city of London, before Lord Alvanley and a special jury, which had excited a good deal of attention amongst scientific men, with regard to those improvements in the construction of the copper-heads, which, with various modifications, are now pretty generally adopted in the brewery, for the purpose of heating the liquor for the succeding mashes, by the steam of the worts during the process of boiling them.

The plaintiff was Mr. Hare, a gentleman of Bath, who was some years since the owner of an extensive brewery at Limehouse; and the defendants were Messrs. Harford and Taylor, his successors in the concern. The action was brought on a bond, conditioned for the payment of an annuity to Mr. Hare, during the existence of a patent, granted to him in September, 1792, in consideration of his licensing the denfendants to use the invention for which it was obtained. The defendants had pleaded, that one Sutton Thomas Wood had before practised the same thing; that the plaintiff's invention was therefore not new, and the patent consequently void. The question therefore was respecting the similarity or dissimilarity of the two inventions of Mr. Hare and Mr. Wood.

Mr. Hare's patent had been granted for "An apparatus, whereby the essential oil of hops, which was "before lost and dissipated in the air during the opera- "tion

"tion of boiling worts for beer, is preserved and applied "to use; and the water for brewing *at the same time* "heated to a sufficient degree of heat without any appli-"cation of fire to the vessel containing it."—Mr. Wood had previously, in 1785, obtained a patent for "Certain "new discoveries in the application of steam; and also "certain methods of using the water produced from con-"densed steam, and for applying the water from the "coppers or boilers of steam-engines to other purposes "than that of working the steam-engine; and also vari-"ous methods of heating and applying water for the "several purposes of the breweries and distilleries, and "for forwarding the process of brewing; and also certain "methods of constructing and adapting coppers, boilers, "tubes, and other hollow bodies, for the more effectual "means of heating water and worts; and of rendering "such coppers, boilers, tubes, and other hollow bodies "as are employed in the breweries and distilleries, steam "and air-tight"—in the specification of which he had said nothing respecting the preserving the essential oil of the hop.—It seemed, however, to be admitted, that if the same purposes as those for which Mr. Hare's patent had been granted had been really effected by Mr. Wood, it would notwithstanding have invalidated the subsequent patent.

Mr. Hare's contrivance, of which a model was produced in court, consisted of a basin or concave vessel placed over the dome or head of the copper; in which basin the liquor for the succeeding mashes was to be contained. From the centre of the dome proceeded a large perpendicular trunk, provided with safety valves on the top, from which trunk issued a horizontal tube, having three smaller tubes suspended from it, whose extremities were immersed in the water in the basin; so that

all the steam which issued from the copper during the process of boiling the worts must necessarily (except in the event of its acquiring sufficient elasticity to open the safety-valves) pass into it, and could only rise into the atmosphere by bubbling up through it from the extremities of these small tubes. The steam thus combining with the water heated it very rapidly; and at the same time impregnated it strongly with the aroma of the hop.

Mr. Wood's invention consisted of a basin somewhat similar in form to Mr. Hare's, but the difference was, that instead of the steam from his copper being mixed, or brought into contact with the water in the basin, it was carried off by a trunk, and applied to work a steam-engine during the boiling of the worts.

It was contended on the part of the plaintiff, that this contrivance was totally different from his, inasmuch as it was no part of Mr. Wood's object to preserve the aroma or essential oil of the hop, which was the primary object of Mr. Hare's patent; and that even with respect to the heating the water, which was only performed in Mr. Wood's basin by the heat transmitted through the dome from the steam below, it was by no means accomplished in the same degree, or in a sufficient degree for the purpose of brewing.

Mr. Wood, who was called on the part of the defendants, explained the nature and effect of his invention, and that it was antecedent to Mr. Hare's.—He stated, that he had once entertained an idea of preserving the essential oil of the hop, but that the experiment had failed, and he did not think it worth repeating.

A number of scientific persons were called on the part of the plaintiff, who stated their opinions as to the dissimilarity in principle and effect between the two inventions; and their reasons for conceiving that the objects of

the

the plaintiff's patent could not be attained by Mr. Wood's apparatus. On the part of the defendant, several scientific gentlemen supported a contrary opinion.

The jury, on the Lord Chief Justice's proceeding to sum up the evidence, appearing previously to have made up their opinions, and inclining, through the whole course of the trial, to the side of the defendant, pronounced their verdict without any hesitation, and in a manner so prompt and decided, that Lord Alvanley declared, that in all future trials, when their minds, from the evidence, were so manifestly satisfied, he would not trouble them with a recapitulation, on their declaring their sentiments.—Verdict for the Defendant.

We shall publish the specifications of the above patents in an early number of this work.

Repeal of Mr. Murray's Patent for Improvements on the Steam Engine.

The KING *v.* MURRAY.

This was a cause instituted by his Majesty's Attorney General, by a writ of *scire facias*, to repeal a patent granted in August, 1801, to Mr. Matthew Murray, of Leeds, for "A method of constructing the air-pump, "and sundry other parts belonging to a steam engine, by "which a considerable saving will be made in the con-"sumption of fuel, and an increased power obtained *." The prosecution was carried on at the instance of Messrs. Boulton, Watt, and Co. of Soho, with a view principally to prove that all those parts of the invention in question, which were really new and useful, and deserving of a patent, were invented and practised at their

* For the specification of this patent see the XVIth vol. page 298, of the first series of this work.

works for a considerable time before the date of this patent.

It was appointed for trial before Lord Ellenborough on Saturday 9th of July last. On the preceding day the defendant withdrew his plea, and consented that judgement should go against him by default, which has accordingly been entered, and the patent is thereby cancelled and repealed.

Canal in Scotland, from the North Sea to the British Channel.

The sum of 20,000l. was lately voted by parliament towards making a navigable canal through the Highlands of Scotland, from sea to sea. The extent is 59 miles, 29 of which are occupied by lakes of unfathomable depth. The remaining part is to be 20 feet deep, and of a proportionate breadth, so that ships of the line may pass from the North Sea to the British Channel. This will obviate all the difficulties of going round about by the Shetland and Orkney Islands, a passage of 14 days in the calmest weather, and which in the stormy season is seldom effected in less than three months. On the contrary, the passage by the proposed canal will not occupy more than twelve days, and frequently little more than half that period.

State of the Tin and Copper Mines.

Many of the Cornwall tin-mines are at present exhausted, and some others are worked to little advantage. Posgooth, the greatest tin-mine in the world, though it produces large quantities of ore, is, however, attended with so great an expence, in consequence of its depth, that it yields but small profits to its proprietors. Some mines

mines near the Land's End, which, for some years, produced but little, are now working to more account. The manufacturers complain that the metal brought to market is less pure than heretofore.

The copper mines are also in general falling off, and some are relinquished in consequence of their depth. Dolwath has, however, at an enormous expence, been brought into work, and yields an abundance of indifferent metal.

Inoculation of Sheep for the Scab.

Count Sergi de Romanzow, of Petersburgh, has lately made an experiment of considerable importance to farmers. He inoculated all his flock for the scab, and out of 2300 sheep, which were subjected to the process, not one died of the disease.

Improvements on Fire Places.

Dr. Joseph Barth, a physician of Vienna, has invented an economical fire-place, of a very simple construction, which requires much less fuel than any hitherto known. The emperor has ordered a certain number to be made on this plan, and the description to be published.

Society of Arts of La Sarthe.

The Society of Arts of the Department of La Sarthe, which meets at Mans, proposes for the subject of its first prize, to be decreed in the year 1803, a medal, or the sum of 300 francs, at the option of the author of the best memoir of the following question: What is the best method of improving the uncultivated lands of the department of La Sarthe?

For

For a second prize, the Society offers a medal of the value of 200 francs, to the author of the best memoir on the question: What is the best method of restoring the manufactures of La Sarthe to their former flourishing state?

None of the resident or corresponding members are admitted to be competitors; but, nevertheless, they are invited to turn their attention to the above subjects; and the Society will take every opportunity of recommending to notice those who shall deserve its approbation.

Meteorology.

The following is an account of the depth of rain fallen in Liverpool in the first six months of the present year; and the evaporation of water out of a vessel four inches diameter, placed out of the reach of the solar rays, or influence of fire.

1803.	Depth of Rain.	Evaporation of Water, &c.
	Inches.	Inches.
January	1,95	1,25
February	1,8	1,4
March	1,25	1,6
April	1,75	2,4
May	1,7	2,7
June	3,28	2,56
Total . . .	11,73	11,91

List

List of Patents for Inventions, &c.

(Continued from Page 160.)

JOHN GAMBLE, of Leicester-square, Middlesex, Gentleman; for improvements on, and additions to, a machine for making paper in single sheets, without seams or joinings. Dated June 7, 1803.

JOHN RANDALL PECKHAM, of White Lion-street, Clerkenwell, Middlesex, Watch-maker; for improvements on a lock to a musquet, fusee, carbine, fowling-piece, or pistol. Dated June 10, 1803.

JAMES FUSSELL, of Mells, Somersetshire, Iron-manufacturer; for a method of working water-wheels, for raising of water, and in a great measure preventing water-wheels from being flooded, and other useful purposes. Dated June 14, 1803.

JOHN WOOD, of Manchester, Lancashire, Machine-maker; for improvements upon machines for spinning and reeling of cotton. Dated June 14, 1803.

JAMES THOMSON, of the city of Edinburgh, Bell-hanger; for improvements in the hanging of bells, window-curtains, window and other blinds. Dated June 14, 1803.

JOHN HARRIOTT, of Wapping, Middlesex, and EDMUND COBB HURRY, of Gosport, Southampton, Esquires, and WILLIAM CRISPIN, of Gosport aforesaid, Shipwright; for a method of making and working windlasses. Dated June 14, 1803.

THOMAS NEWSTEAD, of Kingston-upon-Hull, Yorkshire, Chemist; for a method of preparing barilla and kelp, and the neutral salts obtained therefrom. Dated June 18, 1803.

PETER

Peter Storck, of John-street, Tottenham Court Road, Middlesex, Baker; for a substitute for brewer's yeast, which may be made and used in all weathers and climates. Dated June 21, 1803.

Thomas Brown, of Alnwick, Northumberland, Whitesmith; for a machine for the cutting of tobacco, tallow for tallow-chandlers and soap-boilers; and also for the cutting of turnips, cabbages, carrots, and other kind of roots, for the feeding of cattle. Dated June 21, 1803.

Joseph Everett, of Salisbury, Wiltshire, Clothier; for an article manufactured of different materials, and wove in a peculiar manner, so as to give it an appearance of velvet, which he denominates, "*Salisbury Angola Moleskin.*" Dated June 28, 1803.

George Woods, of Barbican, in the city of London, Gentleman; for a method of constructing harps, harpsichords, piano-fortes, violins, guitars, and other stringed musical instruments. Dated June 28, 1803.

Archibald Earl of Dundonald; for a method of treating or preparing hemp and flax, so as materially to aid the operation of the tools called hackles, in the division of the fibres, and which is likewise attended with other advantages. Dated June 28, 1803.

Edward Warner, the younger, of Little New-street, in the city of London, Brass-founder; for an improvement upon the air-lamp, the properties whereof consist in reflecting a more general and stronger light by means of certain valves, and a newly-constructed burner. Dated June 29, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XVI. SECOND SERIES. SEPT. 1, 1803.

Specification of the Patent granted to PETER STORCK, *of John-street, Tottenham Court Road, in the County of Middlesex, Baker; for a Substitute for Brewers' Yeast, which may be made and used in all Weathers and in all Climates.* Dated June 21, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Peter Storck do hereby declare that the nature of my said invention of a substitute for brewers' yeast, which may be made and used in all weathers and in all climates, and the manner in which the same is made and performed, is described and specified in manner following; that is to say:

To make the Fermentation *.—Take six pounds of malt and three gallons of boiling water, mash them together,

* It is hardly necessary to remind our readers, that we never venture to alter the language of patentees.—Specifications being legal instruments, we think it our duty to give the exact words of the enrollment.

cover it close, let it stand three hours; then draw the liquor off, and put two pounds of brown moist sugar to each gallon of the liquor; stir it well about in the vessel until the sugar is dissolved; then put it in a small cask, only large enough to contain it; cover the bung-hole of the cask with brown paper only; let it be blood-warm; take care not to keep it in a cool place, lest you check the fermentation; let it stand four days: then prepare the same quantity of malt and boiling water in the same manner as last mentioned, without sugar. Take the fermentation out of the vessel; mix it well together with the last-mentioned liquor, when blood-warm; let it stand forty-eight hours, when it will be fit for use. This fermentation, thus prepared, renders it unnecessary to make any new store whilst any of the same remains. To make twenty-six gallons (ale-house measure) of the substitute, allowing to each gallon two pounds of malt and one ounce of hops, and so in proportion for a less or greater quantity.

The Process. — Put twenty-six ounces of hops to twenty-six gallons of water; boil it for full two hours, so as to reduce the liquor to sixteen gallons. Then take the sixteen gallons of liquor so boiled, and mash it with the malt, when the liquor is one hundred and ninety degrees in warmth, or near boiling heat; let it stand two hours and a half, and then drain it off; put it in a clean vessel or cooler; take ten gallons of boiled water, of the same heat; mash it up with the before-mentioned malt; let it stand two hours and a half; then drain it off in another vessel or cooler. Take the first liquor, so prepared, when blood-warm, (or according to the state of the atmosphere at the time of making it,) and put to it four quarts of fermentation hereinbefore specified; mix it well; let it stand ten hours. Take the remaining ten gallons

gallons of the liquor, and put it with the said sixteen gallons of liquor, so prepared as hereinbefore is mentioned; let it stand six hours, and then it is fit for use, in the same manner, and for the like purposes, which brewers' yeast is made use of. A proportionable quantity of this substitute should be reserved as a store, for the purpose of fermenting other liquor, so as aforesaid prepared, to make more substitute for yeast. The advantages attending this invention are, that the substitute for yeast will keep sweet and good longer than brewers' yeast, may be made and used in all weathers and climates, and is the means of making bread more white and lighter than brewers' yeast.

Directions how it is to be used.—Two gallons is sufficient for twelve bushels of bread, set quarter sponge, blood-warm; let it come to its full height, which it will do in four hours, or rather more; and keep it cooler than brewers' yeast throughout the whole process.

In witness whereof, &c.

Specification of the Patent granted to CHESTER GOULD, *of Red Lion-street, Clerkenwell, in the County of Middlesex, Gentleman; for a Glass, on a new Principle, to be used by Mariners at Sea instead of the common Sand Glasses when heaving the Log, for the Purpose of ascertaining the Ship's Rate of sailing, and also for other Uses on Land or at Sea.* Dated May 28, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Chester Gould do hereby declare, that the nature of my said invention, and in what manner the

same is to be performed, are as follows; that is to say: Instead of the half minute and quarter minute sand glasses now commonly used at sea when the log is thrown for the purpose of ascertaining the ship's rate of sailing, I procure to be blown glasses about the shape and size of an orange, or of a hen's egg, with a small hole in each end. These holes I enlarge with a small round file, such as is used by watch-makers, till the glass, being filled with water, will empty itself at one end in half a minute, and at the other end in fifteen seconds; or such other period of time as convenience may require, thereby making one of these glasses answer the purpose of two sand glasses. The shape and size of these glasses, as described above, I consider to be as convenient and proper as any other shape or size; yet in these respects they need not to be limited, but may be varied according to the fancy of those who are concerned in manufacturing and using them, provided they are made to run out exactly in the time required. Some I make to measure time at one end only, leaving the other end open, so that they may be more readily filled. When they are prepared for use, they are filled with water by immersing them in a bucket, or other vessel of water, and the water prevented from escaping till the proper time, by placing the thumb over the hole at one end of the glass. They are used in the same manner and for the same purpose at sea as the common sand glasses are. They are much more correct and uniform in their action, and less liable to accident. They may also be made to run a longer time, to answer several purposes on land as well as at sea.

In witness whereof, &c.

Specification

Fig 1.

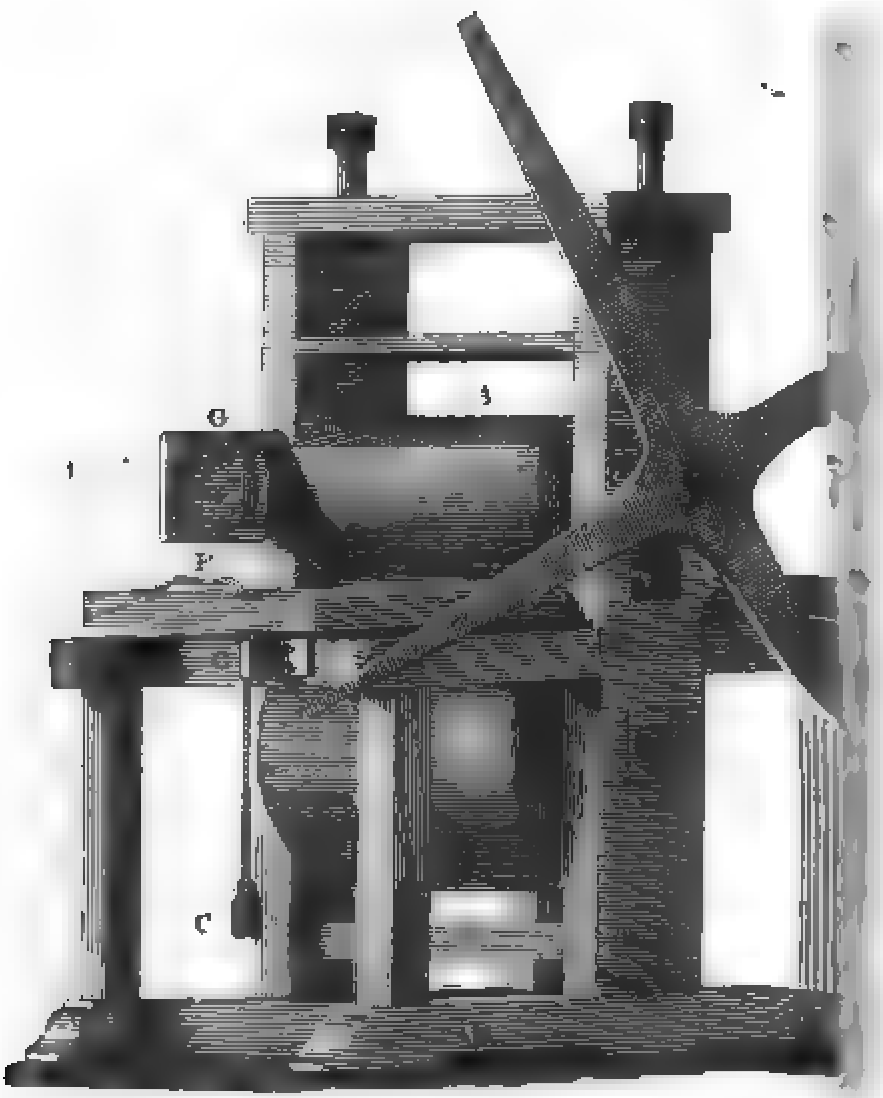
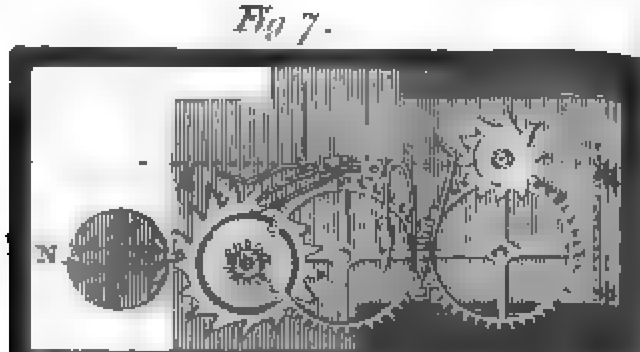


Fig 7.



R Roffe

Specification of the Patent granted to ROBERT KIRKWOOD, *of Edinburgh, Engraver, and Copper-Plate Printer; for certain Improvements on the Copper-Plate Printing-Press.* Dated February 28, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Kirkwood do hereby declare, that the nature of my said invention is particularly described as follows; that is to say: In the usual method of copper-plate printing, the paper on which the impression is to made being laid on the plate, and both laid upon a plank, the whole are passed through between two cylinders, which press on one another, revolving on axes.

In printing common work the pressman passes the plate and paper through, and returns them to himself, remaining in the same place for convenience. This mode of passing the plate and impression twice through the cylinders often doubles the impression, and always renders it coarse and obscure.

For a more perfect impression, the pressman passes the plate and paper only once through, that is, from himself to the other side of the press, and then, going round, carries back the plate and impression to his former situation. This is called printing *through press*, and, requiring more time and trouble, is generally charged double both by the journeyman and master. My improvements are as follows, *viz.*

The circular form of the upper cylinder is interrupted, broken, or altered, by a part of it being in some degree flattened; so that when all the remaining circular part of it, in turning round, has borne on the plate, the flat part

part is then presented to the plate, which causing a vacuity, (at the same time, the upper cylinder being supported,) the pressure on the plank and plate is at an end, and they are returned by machinery or the pressman to their former position, where he remains to receive them, and repeat the operation.

I add, when required, a movement, by clock-work, forming part of the press, for the purpose of numbering the impressions. This movement is described by the annexed drawing and explanation; but any other apparatus producing the same effect may be applied.

The interruption or alteration of the circular form of the cylinder is made on one or more parts of it, according to the size of the plate, or different cylinders may be used for different-sized plates.

Another means of improving copper-plate printing-presses is, to retain the circular form of the upper cylinder, and make interruptions or alterations on the lower cylinder, at the same time fixing two rollers or other support for the plank to be drawn back upon, while unsupported by the lower cylinder.

Another means of producing the desired effect is, to preserve the circular form of the upper and under cylinders, and raise or suspend the upper cylinder, or lower the under cylinder, by a lever on each side of the press, or other mechanical contrivance, in order to allow the plank and plate to return to the workman without passing twice through the cylinders, or obliging the workman to go round the press, or reach over the upper roller for his plate and impression, as is usual in printing through press.

The annexed drawing and references will more fully exemplify the application of my said invention.

In witness whereof, &c.

REFER-

References to Plate X.

Fig. 1, a perspective view of the press.

A, the circle of the roller interrupted; which, by being supported, permits the plank to be drawn back after the circular point has borne on the paper and plate.

B, the lacing or fastening of the blankets, (see Fig. 4.)

C, C, a pulley and weight, which draws back the plank when the interception is presented to the paper and plate after the circular part has compleated the impression.

D, a rope (another of which is on the other side of the plank) which checks the plank in bringing it to its former position, (see Fig. 3.)

E, a small roller, the width of the frame on which the plank runs when it is pulled back, (see Fig. 3.)

F, a handle fixed to the plank, by which the pressman directs and steadies the plank in returning it.

G, an index, for numbering the impressions; effected by the motion of the upper roller, which cannot be moved when the motion of the press is reversed.

Fig. 2, side-view of the press.

A, A, A, A, dotted lines, represent the two interceptions (same as A A, Fig. 5.)

H H, support to the rollers when a flat side is presented to the plank.

I, I, the circular parts of the roller, which press alternately on the paper and plate, and thereby make impressions, (same as Fig. 6.)

D, one of the check ropes, (described in Fig. 1.)

E, a small roller, at the back of the press, (as Fig. 1.)

Fig.

Fig. 3, a back-view of the press.

K K, space between upper roller and plank, when one of the flat sides is presented to the plank.

E, the small roller affixed to the frame of the press, on which the plank runs when it is pulled back.

L L, brass sliding frame, for ditto to adjust it to the proper height, (see Fig. 6.)

D D, two ropes, which check the plank.

Fig. 4, the upper roller by itself.

I, I, the two circular parts, as described in Fig. 2.

A A A A, one of the flat sides.

B, the lacing or fastening of the blankets to the pins M.

N, N, two points, by which the index is effected, (see Fig. 7); these points to be more or fewer according to the number of interruptions in the circle of the roller.

Fig. 5, an end-view of the upper roller, as described in Fig. 2.)

Fig. 6, the two brass frames for small rollers, (as Fig. 3.)

Fig. 7, the index.

O O, the end of axle of upper roller.

N, N, two points fixed to ditto, to effect the index.

Specification

Specification of the Patent granted to Robert Mason, *of St. Thomas's-street, Portsmouth, in the County of Southampton, and late of Cumberland-street, Portsea, in the said County, Gentleman; for certain Improvements on a common Waggon, whereby the same may occasionally be separated and used as two Carts, denominated "The Patent Hampshire Waggon."*

Dated February 28, 1803.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Robert Mason do hereby declare that my said invention is described in manner following; that is to say: The waggon is formed by two distinct frames or parts, which I term the fore and hind carts, as they correspond with the fore and hind parts of a common waggon, with the exception only as to the pole, those carts having one each; that of the fore cart turns upwards from the main pin on the under side thereof. A roller may be fixed for the sweep of the hounds to lock on until it reaches the back shudlock, to which it is secured, and extends about four inches behind the extreme thereof, which projection passes under the fore shudlock of the hind cart, through which and the said projection of the pole an iron pin is to pass, and secured on the under side by key, or nut and screw. The pole of the hind cart to proceed from the hind shudlock through the pillow or axletree, turning upward to the front shudlock, being secured thereto, and extending about four inches from the extreme thereof; which projection passes under the hinder shudlock of the fore cart, through which and the said projection of the hind pole an iron pin is to pass, and secured, as described, with the pole of the fore cart.

As the projections of the two poles are to pass close to each other, it is necessary one should incline to the right, and the other to the left.

The pins here described as passing through the shudlocks and projections of the poles, by which the carts are in part united, are to be removed, and passed through the bed into the fore axletree, one on each side the main pin, to prevent its locking when used as a cart. The sides and shudlocks of the carts are united with hooks and eyes, or other substantial fastening; but the most simple and secure that I recommend, is two strong iron straps, fastened to the top and bottom sides, nearly at each end of the hind shudlock of the fore cart, so as to run and pass on the sides thereof, and projecting behind the shudlock about two inches and a half, with an eye or hole in such projection. These straps I term union eyes: one union eye, of a similar description, is fixed to the centre of the front, nearly at each end of the fore shudlock of the hind cart, by two straps clasping the shudlock, one passing over and the other under the sides of the said cart, so as to come in contact, and fill up the whole space between the two union eyes, described as being nearly at each end of the hind shudlock of the fore cart. The centre of these union eyes should be exactly in a line with the meeting of the two shudlocks to which they are secured; and these union eyes may be made square to their extreme end, or snipe-billed, or wedge-like, which I should rather recommend, as it would tend to unite them the more easily. Also two other union eyes are fixed one on the under side of each of the upper raves of the fore cart, at the hind part thereof, and two others fixed one on each of the upper raves of the hind cart at the front thereof. The eyes and holes in those fixed to the upper raves I would recommend to be square, and those

on

on the shudlocks round; these union eyes may be placed *vice versa*, that is to say, four on the fore shudlock of the hind cart, and two on the hind shudlock of the fore cart; and on the top of the upper raves of the fore cart, and on the under side of such raves of the hind cart, instead as above set forth; so that the whole five union eyes on each side of the waggon are in contact, through which a long iron pin is to pass, which may be square, from the top or head thereof, until it meets the shudlock, and thence round, to correspond with the union eyes on the shudlocks, and may be sufficiently long to pass through an iron strap, fixed for that purpose to the shafts of the hind cart, and secured at the under side thereof by a key, or nut and screw. It will be necessary to put a strouter iron on each side, and within about two inches of the extreme end of the fore cart; and also a strouter iron on each side, within about the like distance from the front of the hind cart. The shafts of the hind cart are to be united thereto in the usual way, and to pass under the bed, and on the pillow of the fore cart. The front bolt of the hounds to be brought forward near to the extreme end or nose thereof, which will tend to resist the strain in locking, as the hounds pin passes behind the said bolt in securing the shafts to the hounds. The nose of the hounds I would recommend to curve a little upwards; it will tend to throw the shafts somewhat higher when used as a cart.

When the waggon is divided and used as carts, the shafts of the fore carts are to be removed back on the hounds about ten inches to other holes, which now come in contact for the hounds pin to pass through, to secure the shafts to the hounds. By the shafts being thus moved back on the hounds, the nose thereof is brought nearly to the hind bolt of the shafts, a piece of iron or

wood being fastened on the under side thereof, to prevent the hounds dropping down or passing through the shafts. There may be two straps of iron, which I term struts, fastened one withinside of each of the sides of the fore cart by an iron pin, and, having an eye at the lower end thereof, through which the hounds pin should pass when securing the shafts to the hounds, as these will tend to support the front part of the cart, as also the hounds, in tipting to discharge a load. These struts may be laid up under the bed when a waggon, by hooks placed for that purpose. There must then be another hole on each side of the shaft nearer to the bolts, to come in contact with these holes in the fore part of the hounds that are occupied by the hounds pin when a waggon. Through these another long pin, or two short ones, are to pass, to secure and depress the nose of the hounds to the shafts; which pin or pins are to be fastened by keys, or nuts and screws; but in case the carts are to be used as tip-carts, then the shafts of the fore cart being fastened to the hounds and struts by the hounds pin only as above described, a strap of iron is to clasp the front bolt of the hounds, being secured at the top and bottom sides, and projecting from the front thereof about three inches, having in such projection a mortise or square hole in the top, and another corresponding therewith, only being a little longer in the under side: these holes must be in contact with each other. These straps I term the tip-strap, through which an iron bar, corresponding with the mortise holes, is to pass, having several holes therein, and a stop at the top, to prevent its passing quite through, this I term the tip-iron, and which is to be received at the under side of tip-strap on a strong hook, fixed at the under side, and at the back of the hind bolt of the shafts, or on a strong iron pin, similar to the hounds pin, which is

is to pass through a strap of iron fixed to the under side of each side of the shaft, so that, by putting a small iron key though either of the holes in the tip-iron above the tip-strap, the nose of the hounds may be depressed or elevated, as occasion may require. I should recommend this tip-iron to be a little curved, so as to come just under the fore part of the bed of the cart. The shafts of the hind cart are to be fixed with hooks and eyes, or other usual fastening, having a staple fixed to, or mortise in, the front bolt, or in a cross bolt fixed thereto for that purpose; and another strong strap of iron, with a mortise therein, fixed to the under side of the front shudlock to the projecting part of the pole. These two mortises are to be in contact, so that a tip-iron, similar to that for the fore cart, may pass through both, having a stop at one or both ends, to prevent its passing through, so that a small iron key being introduced to either of the holes in the tip-iron, the body of the cart is depressed to the shafts, or elevated, as occasion may require. And in order that this tip-iron, if left in this situation when the carts are united, may not hang down, or be in the way, a joint hinge may be made in it, to fold up under the shaft, or a hook may be fixed to the front bolt of the shaft, so as to receive the end of the tip-iron the same as that for the fore cart, so that it can be very easily removed. The tail-board of the fore cart may be secured with either one or two starts, fixed at the bottom thereof, to go into the shudlock, and two other starts from the top rail thereof, one at each end, to drop into the union eyes fixed to the upper raves; but if a narrow tail-board only be required, then two starts are to be fixed at the bottom edge, one at each end, so as to drop into the union eyes of the shudlock, and secured at the under side thereof by a key. The headboard

board of the hind cart to be secured by two starts from the bottom thereof, to go into the shudlock, and having a hole in each end of the top rail to come in contact with the union eyes to the upper raves. Through these the long iron pins, which are used to unite the carts, are to pass, taking the same situation as when the waggon is compleat. Two iron sockets, about five inches long, are to be fixed at the hinder part of the over or outer raves of the fore cart, so as to receive the front ends of the said raves of the hind cart. The head and tail ladders, and all other usual or neccessary things used with common waggons may be applied to this. The head ladder may be removed to the front of the hind cart. If occasion require I have also other ladders, which I denominate side ladders, made of wood or rope, two for each side, with eyes at the lower ends thereof, to be fastened to two hooks, fixed for that purpose to each of the over or outer raves, one at each end. These hooks may be made to secure such raves to the strouters. As these side ladders are only for the purpose of securing all loose loads, such as barley, oats, hay, &c. and as every waggon may not require them, I wish to conceive myself at liberty to dispose of waggons with or without them. Should it be wished the hind cart to be drawn by horses abreast, or curricle fashion, then the pole of the hind cart to be continued sufficiently long, and pass under the bed of the fore cart, through which the main pin may be made to pass, as also a pin at the hind shudlock of the fore cart.

Waggons of usual pattern or fancy may be made on this principle, but those which are made so that the fore wheels lock entirely under the bed; the fore pole may be dispensed with.

Brewers' drays may also be made to unite on this plan.

In witness whereof, &c.

Experiments

Experiments on the Quantity of Gases absorbed by Water at different Temperatures, and under different Pressures.

By Mr. William Henry.

With a Plate.

From the Philosophical Transactions of the Royal Society.

THOUGH the solubility of an individual gas in water forms, generally, a part of its chemical history, yet this property has been overlooked in the examination of several species of the class of aëriform substances. The carbonic acid indeed is the only gas whose relation to water has been an object of much attention ; and, at a very early period of its history, Mr. Cavendish, in the course of inquiries, the results of which were the groundwork of the most important subsequent discoveries, ascertained, with peculiar care, the proportion of carbonic acid gas condensible in water at the temperature of 55° of Fahrenheit. Dr. Priestley also, about the same period, directed his attention to the saturation of water with fixed air, and contrived a simple and effectual mode of obtaining this impregnation. His apparatus afterwards gave way to the more manageable one of Dr. Nooth ; and this, in its turn, has been superseded by the improved mode of condensing into water many times its bulk of various gases, invented and practised by several chemical artists (as well as by myself), both in this country and abroad.

The influence of pressure, in accomplishing this strong impregnation, was first, I believe, suggested by Dr. Priestley. "In an exhausted receiver," that most ingenious philosopher observes, "Pyrmont water will ac-

"tually

"tually boil by the copious discharge of its air; and I "do not doubt, therefore, that by means of a con-"densing engine water might be much more highly im-"pregnated with the virtues of the Pyrmont spring *."

Before describing my experiments on the effects of additional pressure, in saturating water with gases, it will be necessary to state the results of others; that were previously expedient, to determine the quantity of each gas combinable with water, at a given temperature, and under the ordinary weight of the atmosphere. In a few instances also it was deemed proper to ascertain the influence of different temperatures over the condensation of gases in water.

SECTION I.

On the Quantity of Gases absorbed by Water, under the usual Pressure of the Atmosphere.

In order to attain considerable minuteness in observing the proportion of gases absorbed by water, an apparatus was employed, of which the following is a description.

The vessel A, (Plate XII. Fig. 1,) is of glass, about 2 inches diameter and 4½ inches long. It is graduated into cubical inches, and quarter inches; and furnished at the top with a brass cap, into which a cock *a* is screwed. To the lower aperture a copper tube C is cemented, which is bent at a right angle, the leg nearest the vessel being carried downwards, and furnished with a cock *b*. B, is a glass tube, of about ¼ inch bore, bent at a right angle, and graduated, from a given point, into hundredth parts of a cubical inch. It is attached to the copper pipe, by a tube of Indian rubber D, over which is a

* Experiments on air, arranged and methodized, vol. I, p. 81.

covering

covering of leather, forming a joint, which admits of the vessel A being briskly agitated. When the apparatus is used, it is first filled with quicksilver; a transfer bottle of elastic gum, furnished with a cock, and containing water of a known temperature, is screwed on; and a communication is opened, through the cocks, between the bottle and the glass vessel. The lower cock *b* is then opened, through which the mercury runs out, while its place is supplied by a quantity of water from above, measurable by the scale on A. This transfer is removed, and another containing gas being substituted, a measured quantity of gas is admitted in a similar manner. Strong agitation is now applied, by means of the joint D; and mercury is poured into the tube B, to supply the descent occasioned by the absorption in A; its level being exactly preserved in both legs of the syphon, both at the commencement and close of the experiment. The quantity of mercury required for this purpose, indicates precisely the amount of the gas absorbed.

The only advantage of this apparatus over a cylindrical jar, inverted in the usual way over mercury, is, that, by means of the tube B, very minute degrees of absorption may be measured, which would scarcely be perceived in a wide vessel.

For the more absorbable gases, I found this instrument to answer perfectly well; but, for ascertaining the solubility of those which are taken up by water in only small proportion, I preferred one of different construction. It consisted simply of a glass vessel, of the capacity of 57½ cubical inches, and shaped as in Fig. 2. At *a* was cemented a cock, provided with a screw; and the lower cock *b* was of glass, accurately ground in. The vessel was then filled with water which had been long boiled; a lifting valve was screwed on *a*, the cock being

 open;

the gas employed, with a minute portion of the air of the vessel used for its extrication, a small quantity will always be liberated from the water, whatever pains have been taken to deprive it of air, by previous long boiling, exposure under the air pump, or both in succession. That this is the true explanation appears also from the result of adding to the gas a proportion of common air. Thus, when, at the temperature of 55°, 20 measures of carbonic acid are agitated with 10 of water, at least 10 measures of gas are taken up; but, from a mixture of 20 measures of carbonic acid with 10 of common air, 10 parts of water take only 6 of carbonic acid, or 4 less than in the former instance.

An analogous fact was observed by Dr. Brownrigg *, who remarked that gas does not escape from the water which it impregnates, unless the water be in contact with air: for when the Pouhon water was excluded from air, but, at the same time, liberty was given for its gas to arise into an empty bladder, the gas did not spontaneously separate from the water, but, on the contrary, remained united with it when exposed to the greatest heat of our climate. When the impregnated water, he observes, is thus excluded from air, the gas will escape very slowly, at any temperature less than 110° of Fahrenheit, although such heat be sufficient for the distillation of water; nor can it be wholly expelled by a heat of 160° or 170°, continued two hours. But it is well known, that water saturated with carbonic acid gives up its gas rapidly, when freely exposed to the atmosphere.

In fixing the proportion of carbonic acid gas absorbed, it is therefore necessary to note the quantity of residuum, as is done in the following table.

* See Dr. Brownrigg's Paper on the Pouhon Water, Phil. Trans. vol. LXIV.

Experiment

Experiment.	Temperature.	Measures of water.	Measures of gas.	Quantity absorbed.	Residue.	Absorbed by 100 inches of water.
1	55	13	32	14	18	108
2	85	13	32	11	21	84
3	55	13	24	14	10	108
4	55	10	15	10	5	100
5	55	20	20	13	2	90
6	55	19	19	16	3	84
7	85	19	19	13	6	70
8	110	10	20	6	14	60
9	110	20	20	9	11	45

Since the above table was drawn up, I have been gratified by remarking that, in the experiments of Mr. Cavendish, similar variations in the quantities absorbed were produced by the variable amount of the residua; as will appear from the following deductions from his experiments.

At the temperature of 55°.

1. When the gas absorbed was to the residue as 100 to 164, 100 cubical inches of water took up . . . 116

2. When

2. When the absorbed gas was to the residue as 100 to 16, 100 inches of water took up 107
3. The absorbed gas being to the residue as 100 to 10, 100 parts of water absorbed, ... $102\frac{1}{2}$
4. The absorption being to the residue as 100 to $1\frac{1}{2}$, 100 parts of water took up, ... $95\frac{1}{2}$

The quality of the residuum I only ascertained in experiments 5 and 6 of the preceding table. In experiment 5, the residuary two measures contained $7\frac{1}{2}$ *per cent.* of common air, or 0.15 of a measure. But of those 13 existed previously in the 20 measures of carbonic acid gas; and the 20 measures of water had therefore only given up .02 of a measure, or about $\frac{1}{1000}$ of its bulk. I apprehend, however, that the whole of the common air was not even thus extricated from the water. In experiment 6 the 3 residuary measures contained $\frac{1}{6}$ of common air.

To judge of the influence of temperature, it is essential that the experiments compared should be on similar proportions of gas and water. Thus, from a comparison of experiment 1 and 2, it appears that about $\frac{1}{14}$ of the whole bulk absorbable at 55° is the diminution of the quantity of absorption produced by each elevation of 10° of temperature; and the same inference follows from various other experiments, the results of which I have thought it needless to state *.

* During the absorption of carbonic acid by water, the gas and water having previously the same temperature, there is an extrication of caloric sufficient to raise the temperature of the water between $\frac{1}{2}$ and $\frac{3}{4}$ of a degree of Fahrenheit. The same effect is produced by the condensation of sulphuretted hydrogen and nitrous oxide gases, though less apparently. To perceive this phenomenon, considerable quantities of gas and water should be used.

2. *Sulphureted*

2. *Sulphuretted Hydrogen Gas.*

One hundred parts of water, at 55° of temperature, absorb 86 parts of this gas, obtained from sulphuret of iron and dilute sulphuric acid, a residue being left, equal in bulk to the gas absorbed. At 85°, under similar circumstances, the same quantity absorbs 78.

3. *Nitrous Oxide.*

At 45°, 100 cubic inches of water take up 50 of nitrous oxide; and at 70°, the same quantity takes up only 44. According to Mr. Davy, in whose experiments, from his intimate knowledge of this gas, and skill in its preparation, I place more confidence than in my own, 100 inches of water at 45° take up 54 of nitrous oxide, the residuum being about one half the volume of the gas absorbed.

4. *Less absorbable Gases.*

The experiments with those gases which are absorbed only in sparing proportion by water, I could not conveniently make at more than one temperature; nor indeed did the object appear to me worthy of the time and attention which such a repetition of them would have required. Of the accuracy of the following, however, I satisfied myself, by repeating each two or three times; and with gases of the greatest attainable purity.

100 cubic inches of water at 60° absorb,

Of nitrous gas	5	inches.
Oxygenous gas	2.63	
Phosphuretted hydrogen ditto	2.14	
Gaseous oxide of carbon	2.01	
Carburetted hydrogen gas	1.40	
Azotic gas	1.20	
Hydrogen gas	1.08	

The

The solubility of atmospherical air cannot easily be ascertained; for, as I shall hereafter shew, in a memoir on the expulsion of gases from water by each other, air is decomposed by agitation with boiled water, its oxygenous portion being absorbed in preference.

From the statements given by various philosophers, (the Abbé Nollet, Drs. Hales, Priestley, and Pearson,) of the quantity of air separable from water of different kinds, by heat or a diminished pressure, I expected that a much larger proportion of the gases constituting the atmosphere would have been absorbed by water, than the above numbers assign. It is to be recollected, however, that no method hitherto discovered detaches from water all its air; and the unknown quantity remaining in it, after these modes of separation have been employed, is to be added to that with which a given volume of water can be artificially impregnated. Dr. Pearson, in his enquiries into the nature of the gas obtained by passing electric discharges through water, was at great pains to purify the subject of his experiments from air, by boiling and a powerful air pump; but he always found, that after the full effect of both these methods, electricity liberated a farther, and not an inconsiderable, portion of air *.

Common spring water may, I think, be fairly taken as a specimen of water fully charged with atmospherical air; and, with the view of determining the quantity and kind of gases extricated from it, I made the following experiment. A glass globe, of the capacity of 117½ cubical inches, was filled with water fresh from the well. To its mouth was adapted a curved and stoppered tube, which held ¾ of an inch; and this was also filled with

* Philosophical Transactions for 1797.

water.

water. The globe was then placed in a vessel of brine, which was kept boiling between six and seven hours, and the gases were received over mercury. Their quantity and quality were as follows.

No.	Cub. inches.	Consisted of Carbonic acid.	Air.	Proportion of oxygen gas in the residuary air.
1	1.25	0.50	0.75	0.20
2	1.25	0.85	0.40	0.16
3	1.63	1.23	0.40	0.16
4	0.50	0.49	0.01	lost by accident.
	4.63	3.07	1.56	
Air remaining in the bent tube	0.75			
	5.38, total gas from 117¼ inches of water.			

But 4¼ inches of water were expelled owing to the expansion by heat. Therefore 117½ — 4¼ = 113 inches of water gave 5.38 inches of gas; and 100 inches consequently gave 4.76, of which 3.38 were carbonic acid, and 1.38 atmospherical air. Hence the water afforded about $\frac{1}{70}$ its bulk of atmospherical air, and $\frac{1}{20}$ of a mixture of gases. In this estimate, the gas remaining in the tube is reckoned as carbonic acid, which may be allowed, since the portion last obtained held only $\frac{1}{50}$ its bulk of common air.

SECTION II.

On the Influence of Pressure in promoting the Absorption of Gases; and the Description of an Apparatus for exhibiting this Phenomenon.

For the purpose of determining the ratio between the addition of pressure and the increased absorption of gases by water, I employed the apparatus, with some addi-

 tion,

tion, which has been already described. The tube B was lengthened at pleasure, with the view of obtaining, by a column of mercury, any additional pressure that might be required. The vessel A, Fig. 1, was then filled completely with mercury, which rose to its corresponding level in the tube B. A given quantity of water, of a known temperature, and afterwards a measured volume of gas, were transferred into the vessel, in the mode already described; and as the mercury, by opening the cock *b*, was brought to the same level in both legs of the syphon, the gas, it is evident, must have been under the ordinary weight of the atmosphere. A quantity of mercury was next poured into the leg B, sufficient to form a column 28 inches higher than the level of the mercury in A, after this addition; and the bulk of the gas was again noted. This was found to be, pretty exactly, $\frac{1}{2}$, $\frac{1}{3}$, &c. of the space occupied before, when one, two, or more additional atmospheres were applied. Brisk agitation was now used, as long as any absorption took place; and into the tube B an assistant poured mercury, so as to preserve in it the excess of 21 inches above the level of the mercury in A. The degree of absorption was known by the scale on A, or more accurately by the quantity of mercury required to support the elevation of 28 inches in B.

By lengthening the column in B to 56 inches, the pressure of two additional atmospheres was obtained; and this was the utmost extent to which the addition of weight could be carried without forcing the joint at D.

When the cock *b* was opened, and the column in each leg thus suddenly fell to the same level, the water, which had been previously charged with gas, under a pressure of three atmospheres, effervesced violently; but some time elapsed before the additional gas, forced in by compression,

pression, was wholly evolved. These appearances are very striking and amusing; and are well calculated for exhibition in a chemical lecture. The apparatus, however, I have no doubt, may be greatly improved; but, at the distance of nearly 200 miles from the metropolis, I was under the necessity of using such an one as could be constructed by my own hands.

A considerable improvement in the construction of the apparatus, which would obviate the expediency of the flexible tube D, would be the following. To the lower neck of the vessel A, Fig. 1, let a cap and cock, with a female screw be cemented; and let the upper end of the pipe C be terminated by a cock with a male screw. Introduce the gas and water in the manner already described; apply the increased pressure; and, having shut the two additional cocks, unscrew them from each other. The vessel A will thus be attached, and agitation may be easily applied; after which again screw it into its former place, and on opening the two cocks the mercury will rise in the vessel A. Supply the descent in B by fresh mercury, and proceed as before, repeating alternately the pressure and agitation as long as any farther absorption takes place.

A farther amendment of the apparatus would consist in the substitution of cocks of some other metal than brass, which, however perfect at first, are always injured by the repeated action of the mercury. If cocks of glass could be ground sufficiently tight, metal caps with screws might be cemented to them.

For observing the increased absorption of less condensible gases, I found it necessary to substitute a vessel of larger size than A, and of the capacity of at least 50 cubical inches. It is represented by the dotted lines in Fig. 1, and was furnished with a cock and screw at *c*.

As it would have been troublesome to have filled so large a vessel entirely with quicksilver, it was filled with boiled water, with the exception of a quantity of quicksilver rather exceeding the bulk of the gas employed. The gas was admitted, as usual, from a transfer bottle, the mercury which it replaced escaping through the cock *b*. The increased pressure was next applied; and the experiment conducted as before, except that the agitation was much longer continued.

The results of a series of at least fifty experiments on carbonic acid, sulphuretted hydrogen gas, nitrous oxide, oxygenous and azotic gases, with the above apparatus, establish the following general law: *that, under equal circumstances of temperature, water takes up, in all cases, the same volume of condensed gas as of gas under ordinary pressure.* But, as the spaces occupied by every gas are inversely as the compressing force, it follows, *that water takes up, of gas condensed by one, two, or more additional atmospheres, a quantity which, ordinarily compressed, would be equal to twice, thrice, &c. the volume absorbed under the common pressure of the atmosphere.* By frequent repetition of the experiments I obtained results differing a little from the general principle above stated; but, for all practical purposes, I apprehend, the law has been announced with sufficient accuracy *.

In place of the cock *a*, I cemented, in one experiment, a very sensible thermometer. The vessel was next filled with mercury through the cock *b*; and the tube B being also filled, the cock *b* was shut, and a bottle of carbonic acid gas screwed on. The cock *b* being then opened, the

* That the facts did not, with invariable accuracy, correspond to the law, was perhaps, in part, owing to the addition of only 28 inches of pressure; when, in strictness, 29½ should have been used, or twice the elevation of the mercury in the barometer, during each experiment.

the mercury descended, and a measured quantity of carbonic acid arose into the vessel A. In the same way, a measured quantity of water was introduced. When the density of the air was suddenly doubled by a column of quicksilver, the mercury in the thermometer, whose bulb was still surrounded by the condensed gas, rose about 1½ degree. On agitating the vessel till the water encompassed the bulb of the thermometer, an elevation of barely ¼ a degree ensued in the temperature of the water. This ascent would probably have been greater if the evolved heat had not been carried off by the mercury on which the water floated.

Observations on the Culture and Growth of Oak Timber.

By the Rev. Richard Yates, *F. A. S.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Silver Medal was voted to the Author of this Communication.

To expatiate upon the vast importance of increasing the growth of oak-timber seems unnecessary. The national advantages resulting from this source appear to be in general well understood; and yet the cultivation and management of this most useful plant has not hitherto obtained that degree of attention which it most certainly merits.

Entirely to obviate, or even in some measure to remove or lessen, the obstacles that still continue to impede the planting of oaks, would therefore be rendering an essential service to the nation. The desire of accomplishing

plishing so beneficial a purpose, has induced the judicious and public-spirited conductors of the Society of Arts to propose a premium for "ascertaining the best method "of raising oaks;" in consequence of which, this paper is submitted to their candid consideration. And as the statements here made are founded upon a sedulous and active experience of fifty years, it is presumed the *spirit* and *meaning* of the Society's proposal may have been observed, although it has not been possible (in this instance) *literally* to fulfil its terms; at least, the very intention of promoting and forwarding the views of so enlightened and highly useful a Society, may, it is hoped, be accepted as an apology for calling their attention to these observations.

It forms no part of the present design to enter minutely into the various causes that continue to operate in obstructing the cultivation of oak; as there is one of peculiar magnitude, the consequences of which are highly detrimental and injurious, and which it is therefore the principal object of this paper to remove.

An opinion is generally prevalent, that the oak is particularly slow in its growth, and requires a great number of years before it affords any advantage. This idea too often deters from planting, on account of the very great length of time it is supposed the land must be occupied before any return of valuable produce can be obtained from it, after a considerable expense may have been incurred in forming plantations.

This opinion I consider as entirely founded in error, and to have taken its rise in a great measure from the want of proper management that has hitherto commonly prevailed in the raising of oaks: and in this paper I shall endeavour strongly to state, that the oak may be rendered very rapid in its growth, and that consequently land

land may be employed to great advantage in its cultivation, as a very considerable and profitable produce may, in a much shorter time than is generally supposed, be derived from proper parts of an estate thus employed.

Oak-timber in this country, for the most part, appears in trees of a considerable extent of head, but seldom more than *twenty* or *thirty* feet in stem; and this, in many instances, the growth of a century. Now, by the course of management here proposed, it is conceived that trees, of at least *double this magnitude*, may be obtained in about half that time.

It is not my intention to attempt a proof of this proposition by theoretical deductions, but to appeal for its confirmation to the indubitable test of fact, which, from the event of repeated trials, impresses a conviction, that experience will be found to support and establish it in the most unequivocal manner.

It would be easy to enlarge much on the various qualities of soil, the nature and process of vegetation, and the peculiar properties of the oak; but as these topics may be found amply and judiciously discussed in many other authors, who have expressly treated on these subjects, I shall decline all such speculations; and, with the hope of being more essentially useful, shall confine myself to a statement as simple and practicable as possible.

The oak, in the progress of its growth, spreads numerous roots near the surface of the ground, and in an horizontal direction: these assist in supporting and preserving the tree in its position, but seem to contribute very little to its increase and magnitude. The oak appears to derive its chief nutriment and strength from a root that always descends at right angles to the horizon, and is called the tap-root. The first thing, therefore, to be observed is, that upon a judicious attention to this peculiarity,

culiarity, the planter's success principally depends; and the neglect of this care is the constant source of error and disappointment. In all climates, and upon all soils, to preserve this tap-root from injury, and as much as possible to assist its growth, is a general, and indeed the most essential principle in the cultivation of oak. With a due regard to this circumstance, the management of a plantation may be resolved into the three following practical directions:

Previously to planting the acorns, *loosen* the earth intended for their reception, by *deep trenching*.

Never transplant, or in any way disturb, the saplings intended for timber.

Keep the plant carefully *pruned*, till arrived at a proper height.

More fully to elucidate the subject, and to prevent the possibility of misapprehension, it may be proper to give a more detailed statement.

In determining on a spot to form a plantation of oaks for timber, it must always be recollected that the plants are to remain without removal in their first situation: the clearing and fencing may then be attended to as usual; and in the course of the winter, from September to March, the particular spots intended for the reception of acorns, may be prepared for that purpose, by digging a trench about three feet in width, and from three to six feet in depth, according to the closeness and tenacity of the soil. If grass-ground, the first spit should be placed at the bottom of the trench; and if more than one trench be necessary, they should be prepared in the same manner, preserving a distance of ten yards between each, if it be intended to employ the intermediate space in underwood, or for any other purpose.

Having

Having made a careful selection of acorns that are perfectly sound, and in good preservation, they are to be planted about the middle of March. Draw a drill in the centre of the trench two inches in depth, if the soil be heavy and loamy, but three inches in a light and sandy earth: in this place the acorns two inches asunder, and cover them carefully with mould. When the plants appear, they must be weeded by hand in the rows, and the earth of the trench round them cleaned with a hoe, once a month during the summer. In October inspect the rows, and thin them by pulling up every other plant: attention will of course be paid to remove the weak and crooked plants, and leave those that are tallest and straightest. On the second year, the operation of thinning must be repeated, at the same time, and in the same manner; and, should any of the remaining plants have made side-shoots stronger than the general character, they must be smoothly cut off with a sharp knife, close to the leading stem. On the third year, the thinning is again to be repeated, and the general pruning commenced, by cutting off close to the leading stem all the side-shoots of the first year; thus leaving the branches of two years to form the head of the following year. The removal of every alternate plant must be continued yearly, till the trees are about thirty feet apart, and which distance they may remain for timber. The pruning is to be continued, by removing every year, very smooth and close to the main stem, one year's growth of side branches, till the plants are arrived at a stem of forty, fifty, or sixty feet, and they may then be permitted to run to head without farther pruning.

The particular arrangement here recommended may be varied according to any peculiarities of situation, re-

gard being constantly had to the general and most important principle of loosening the ground *very deep* previously to planting the acorns. By this mode of culture, oaks may be raised in almost any soil; but, where it is possible, a loam or marl is always to be chosen. Oaks thrive much the best in such earth; and, when assisted by *deep trenching* and *judicious pruning*, attain in a few years to an immense size.

Those who have been accustomed to notice the slow growth and stunted appearance of oak trees, when denied the assistance of art, and left to themselves in the common way, would observe with astonishment the vigorous and rapid increase of plants under the management now pointed out.

The plants thinned out the first three or four years though not fit to be depended upon for timber, as transplanting generally injures very materially the future growth, may be re-planted in the intermediate spaces between the rows, for the purpose of being afterwards removed; or they may be usefully placed in hedges, or other spare and unoccupied spots of ground. They should be headed down at the time of transplanting, as this operation assists the process of nature, in re-producing or remedying any injury the tap-root may have received from the removal: and, if proper attention be given to loosen the soil for their reception, and pruning them as they advance, in most instances an adequate profit will be derived from the labour bestowed upon them. After a few years, the produce of the timber-plantation will be found very advantageous. The young trees that are to be removed yearly, will always find a ready market for a variety of purposes, unnecessary here to enumerate. In addition to these advantages, if by this treatment of *deep trenching* previous to planting, and

annual

annual careful pruning during the growth, timber can be produced in about fifty years, of equal quality, and much superior in size, to that which has been above one hundred years growing under improper management, or without the assistance of cultivation; it will doubtless be allowed that a most beneficial, if not absolutely the best possible method of "raising oaks," is here pointed out and ascertained.

This method of cultivation may perhaps be thought to occasion so much expense in manual labour as to prevent its being generally adopted: it might perhaps be sufficient to observe, that if the work be conducted with judgement and economy, the future produce would afford ample returns for all necessary expenditure: it should also be recollected, that the previous preparation of the ground, and the subsequent pruning of the plants, are both to be performed at that season of the year when a scarcity of work will enable the planter to obtain assistance upon easier terms; with this additional advantage also, of providing employment for the labourer at those times when the general state of agricultural business renders it difficult for him to find maintenance for himself and family without charitable relief.

In 1750, at Ingestrie, in Staffordshire, the seat of Lord Chetwynd, some plantations were formed and managed in a great measure according to the principles here stated, and the growth of the plants was so uncommonly rapid, and so extraordinary, that it could not but attract the notice of all concerned in the conduct of them. The attention to the subject, then excited, has been the occasion and ground of all the observations and experiments made from that time to the present, the result of which is given in this paper.

 The

The extensive plantations of the late Lord Denbeigh, at Newnham Paddox, in Warwickshire, are well known and much admired. The whole has been conducted with great judgement. About a square acre has been employed in raising oaks upon a plan nearly similar to that now proposed, and affords the best and most convincing proof of the superior utility and efficacy of such management. Had the noble earl been now living, I should have been enabled to have laid before the Society some more detailed particulars: that, however, is now impossible; this paper, therefore, in its present state, may perhaps be thought not altogether unworthy of notice, as tending to forward the liberal designs of the Society, and contributing to the advantage of the public, the author conceiving that the best method of raising oaks is ascertained and stated in it.

Should the Society be in any degree inclined to join in this sentiment, it may perhaps induce them to make some alteration in the terms of their proposal; as, according to the statement made in this paper, and indeed from what may be seen in every part of the kingdom, in the character and appearance of oaks growing without cultivation, it seems ascertained, that "acorns set with "the spade or dibble, without digging or tillage," can never be depended on to form good timber; and even in the most favourable circumstance of this case, the growth will be exceedingly slow and precarious. The same may be said of "young plants, previously raised in nurseries, "and transplanted;" for if the tap-root be cut, broken, or in any degree injured, which in transplanting it is almost impossible to avoid, that plant will seldom become a vigorous and flourishing tree. To form a course of experiments on such a plant as the oak, is not a very easy matter,

matter. To fulfil explicitly the conditions of the Society would require a great length of time, and would be attended with considerable expense, from which future candidates may in a great measure be exonerated. The raising even one acre in the manner here ascertained might be productive of great pecuniary advantage, if the facts and experience detailed in this paper are permitted to prove the inutility of the other two methods, and consequently to remove the necessity of employing so much ground upon them, at an expense they will never repay.

On Oil used as a Manure. *By* C. Baldwin, *Esq.*

From Hunter's Georgical Essays.

HAVING for many years considered oil as the great pabulum of plants, I was much hurt by the result of some experiments, which state oil as *poison*; and turning this in my thoughts a thousand times over, it at last occurred to me, that though oil, as oil in its *crude* state, might act as a poison, yet it might be so changed as to convey it with great advantage to the soil, and I instantly recollected Dr. Hunter's mode by ashes; it also occurred to me that rape-oil cake was known to be an excellent manure, that no objection had ever been made to it but its expensiveness, and that if it was beneficial to the soil, it could only be so from the quantity of oil contained in it, though that quantity must be very small indeed, considering the process of first grinding the rape-seed, and the vast force used to drive out the oil, so that what

what remains is little more than a *caput mortuum*; yet the cake formed of these very remains is known to be a rich manure.

Think for a moment from how many seeds, plants, shrubs, and trees, we draw oil; from rapeseed, linseed, mustard, fennel, aniseed, juniper, carraways, mint, olives, &c. Thus we evidently draw an immense quantity of oil from the earth, but when and how do we convey any to it? I know of little or no attention paid to this circumstance in our compost dunghills, so that all the oil conveyed to them can only be from animal dung.

Whatever may be the quantity of oil remaining in *each* rape-cake, and I believe that no one will state it at half an ounce each, yet it must be remembered that after all it is only a *vegetable* oil; reflecting on this circumstance, and fully persuaded that *animal* oil must be much superior to it, I directly went to town to inquire the price of whale or train oil, and there I was informed, that it was about 2*s.* 3*d. per* gallon; this I considered as too expensive; but, pursuing my object, I was informed by Mr. Wilfred Reed, oil merchant, in Thames-street, that he could supply me with bottoms or foots of oil, and a rich thick South Sea whale oil, at 14*d. per* gallon.—This was the very thing I wished for, and directly ordered sixty gallons, for a five-acre field, and thus went to work. Having a platform or bottom of twenty load of mould with eight load of dung on it, I carried on three load of light sandy mould, and one load of brick and mortar rubbish, ground fine, and having mixed these well, and made a kind of dish of it, about five feet wide and ten feet long, with a ladle we put over it one half of the oil.—It was in August, and the warmth of the sun soon made the thick oil soak into this compost, when it

was

was directly thrown up in a heap, broke down again, and by five or six turnings, well mixed together, and left in a heap two days, when it was spread equally over the whole dunghill; twenty load more of good mould was then carried on, eight load of dung, and the remaining thirty-gallons of oil were mixed as before, in sandy mould, and brick and mortar rubbish, and equally spread over, and the whole was covered by trimming the four sides of the dunghill, and throwing it on the top.

Thus the dunghill lay more than two months, when it was cut down by mattocks, carefully broke, well mixed, and turned over. The end of March it was carried on the field, spread, and ploughed in; it lay about a fortnight, was then ploughed again, and, on the 22d of April last, it was drilled with the Rev. Mr. Cooke's most excellent drill; I mean his last, with hoes and scarifiers, which I think much superior to his former one: the last I think every farmer, who has seen it at work, will consider as incapable of further improvement. The field was drilled with barley, two bushels to the acre; the crop came up in a most even and beautiful manner; every seed was up within forty-eight hours of each other; all was ripe at the same time, and, from a couple of months after seed-time to harvest, was rated by all who saw it, and it was seen by many, as a sixty bushel crop.

At harvest, three rows were cut across the field, directly thrashed and measured: one load out of thirteen was also thrashed and measured, and both stated the crop to be sixty bushels, but, to wave all possibility of dispute or doubt, I am content to state the crop at seven quarters *per* acre.

As to the quality of the barley, I could here cite the opinion of one of the most eminent brewers in London, who

who saw the crop growing, and declared he would readily give 1000 *l.* to be assured that all the barley crops in the kingdom were of equal burthen and weight; five quarters of it have been lately sent to Nethrapps, in Norfolk, as seed-barley, under the denomination of 15 comb-barley; and an eminent maltster tells me it weighs 220 lb. *per* sack, or 55 lb. *per* bushel, Winchester measure.

Among the many gentlemen and farmers who saw the crop on the ground, was the celebrated Mr. Bakewell; he came with three or four others, and, walking down the field, observed the hedge and bank; the bank, upon being touched with a stick, run down as sand and gravel generally do, and Mr. Bakewell being asked his opinion of the value of the land, if I do not mistake, valued it at 18*d.* *per* acre, but turning to the crop, and desiring his friends to do so also, he admitted that it seemed as if growing on land of 15*s.* or 20*s.* *per* acre.

I must not omit saying that the barley followed oats, upon a lay of six years old, that the land was, as is too common in such cases, much infested with the little red or wire worm, and that the oats suffered much from them; when we were ploughing for the barley the first time, I observed many turned up by the plough, when a distant ray of hope instantly darted upon my mind, that the oil in its then state, or from its strong effluvium, might prove obnoxious to them, and I am happy in saying, that the barley did not suffer from them in the least.

I can, however, add here, that I am now trying that experiment in Hampshire, having last autumn made up dunghill, with twenty gallons of oil, on one-third of it, for a six-acre field, which is now drilled with pease.

It

It is well known that all animal substances, in a state of corruption, wonderfully promote vegetation, and are the actual food of plants.

The whale-oil which I used is an animal substance, perhaps the richest part of the animal; whether I used enough, or what is the proper quantity *per* acre, experience must point out. Say I used eight loads of mould, three or four loads of dung, and twelve gallons of whale-oil, *per* acre.

That oil applied to land, as a food for plants, in its crude state, acts as a poison, I cannot deny, but my process is very different; I believe that oil, particularly animal oil, is the pabulum of plants, that is, oil subtilized by the salts in a compost dunghill, left there a considerable time, in a state of putrefaction, and until the whole is become putrescent, *then*, I say, I *believe*, I have got the best and richest manure that can be carried on land.

The barley evidently proved its excellence; a ridge of summer cucumbers, in my garden, pointed out to many its great power, the leaves being in general from ten to ten and a half inches broad, and the vines occupied an uncommon space of ground. Five hundred cabbages and savoys, planted by the side of four thousand more, and which had only one handful of the oil manure put into each hole made by the dibble, at the time of planting, were evidently near as big again as the others.

On the most profitable Method of managing Light Arable Lands. By the Rev. JOHN BUXTON.

From HUNTER'S GEORGICAL ESSAYS.

A JUDICIOUS course of crops constitutes a most essential part of an arable farm. The following is practised in Norfolk, a country remarkable for the best courses.

First Year. —— Turnips.

1. Plough the stubble up about Christmas.

2. The beginning of March, plough again and harrow.

3. The beginning of April, plough and harrow; but before you begin to plough this third time, spread twelve loads of good manure upon each acre.

4. Plough again a fortnight before Old Midsummer; then sow your turnip-seed, two pints to an acre, and harrow it in. — Hoe the turnips twice.

Second Year. —— Barley and Clover.

Get the turnips off the beginning of March — plough and harrow. Three weeks after, plough and harrow again. The latter end of April, or beginning of May, plough the third time; but before you begin to plough, sow half of the seed upon the land, namely, a bushel and a half *per* acre, then plough and sow the same quantity of seed above furrow. Harrow once; then sow ten pounds of good clover-seed, and let the barley and clover be harrowed in together.

Third Year. — Clover.

Take two crops of clover; or, if you think proper, reserve the second crop for seed.

Fourth

Fourth Year.—Wheat.

A fortnight or three weeks after Old Michaelmas plough your land. As soon as ploughed, throw two chaldrons of hot lime upon each acre. Harrow the lime and the seed in together. Provided the land be clean, I think two bushels of wheat or barley sufficient seed for an acre.

Expense of the Turnip Crop.

	£.	s.	d.
For ploughings and harrowings, at 3*s.* 6*d.* each,	0	14	0
Twelve loads of manure, and carriage, at 5*s.* *per* load,	3	0	0
Seed, two pints, 1*s.* Hoeing twice 7*s.*	0	8	0
	4	2	0

Expense of Barley and Clover.

	£.	s.	d.
Three ploughings and harrowings, at 3*s.* 6*d.* each,	0	10	6
Seed, two bushels, 5*s.* Clover 10*s.*	0	15	0
Reaping 1*s.* 6*d.* Beer 1*s.* 6*d.* Getting in 5*s.*	0	8	0
	1	13	6

Expense of the Clover Crop.

	£.	s.	d.
Cutting and beer 2*s.* Making 1*s.*	0	3	0
Carrying 5*s.* Second crop 7*s.* 6*d.*	0	12	6
	0	15	6

Expense of the Wheat Crop.

	£.	s.	d.
Ploughing once and harrowing, ...	0	4	0
Lime, two chaldrons, 1*l.* Carriage 10*s.* . . .	1	10	0
Seed, two bushels, ...	0	10	0
Reaping 6*s.* Beer 1*s.* 6*d.* Carrying 5*s.* . . .	0	12	6
	2	16	6

Expense of the Four Years.

	£.	s.	d.
Turnip crop, ...	4	2	0
Barley ditto, ...	1	13	6
Clover ditto, ...	0	15	6
Wheat ditto, ...	2	16	6
	9	7	6
Nine pounds seven shillings and sixpence, for four years, makes each crop, upon an average, ...	2	6	10½
Add rent 1*l.* Tithes and rates 7*s.* 9*d.*	1	7	9
Rent, rates, and cultivation *per* acre, ...	3	14	7½

Profits of Four Crops.

	£.	s.	d.
Turnip crop worth, ...	3	0	0
Barley ditto, 36 bushels, at 2*s.* 6*d.*	4	10	0
Clover ditto, first crop, three loads, ...	3	0	0
Second ditto, two loads, ...	2	0	0
Wheat ditto, 28 bushels at 5*s.*	7	0	0
	19	10	0

Nineteen

Fig. 1.

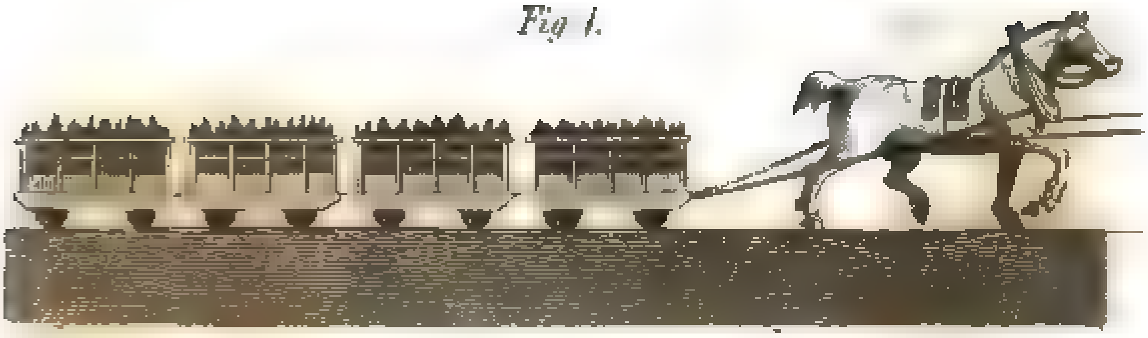


Fig. 2.

	£.	s.	d.
Nineteen pounds ten shillings makes each crop upon an average, ...	4	17	6
Profit *per* acre, ...	4	17	6
Expenses, ...	3	14	6
Clear profit *per* acre . .	1	3	0

Lands cultivated in this manner will never be overrun with weeds; neither can the ground be distressed, as tap-rooted plants regularly follow such as spread their roots superficially.—The system is founded on reason, and supported by experience. Nice farmers dibble in the wheat, dropping three grains into each hole. For this practice a clover lay, after one ploughing, is the most favourable.

Account of the Penrhyn Iron Railway.

Communicated by the Inventor, Mr. Benjamin Wyatt, *of Lime Grove, near Bangor.*

With a Plate.

THE following account of the Penrhyn railway, with the section of the rail, will, I flatter myself, be acceptable to many of your readers. The rail hitherto made use of in most railways is a flat one, three feet in length, with a rib on one edge, to give it strength, and to prevent the wheels (which have a flat rim) from running off. Observing that these rails were frequently obstructed by stones and dirt lodging upon them; that they were obliged to be fastened to single stones or blocks on account

count of their not rising sufficiently high above the sills, to admit of graveling the horse-path; that the sharp rib standing up was dangerous for the horses; that the strength of the rail was applied the wrong way; and that less surface would create less friction; led me to consider if some better form of rail could not be applied: the oval presented itself as the best adapted to correct all the faults of the flat rail, and I have the satisfaction to say that it has completely answered the purpose in a railway lately executed for Lord Penrhyn, from his lordship's slate-quarries, in Carnarvonshire, to Port Penrhyn, (the place of shipping.) The wheel made use of on this rail has a concave rim, so contrived in its form, and the wheels so fixed upon their axes, as to move with the greatest facility in the sharpest curves that can be required. It is plain, by inspecting the section of this rail, (see Plate XI. Fig. 1,) that no dirt can lodge upon it; that it must be stronger than any other form of the same weight, to resist both the perpendicular and lateral pressure; that it must occasion very little friction; that it presents no danger to the horse; and that it may be placed upon the sills, so as to admit of a sufficient quantity of gravel to cover them. These advantages have so forcibly struck all who have seen and examined this road, that I have been induced to lay it before the public through the medium of the Repertory of Arts and Manufactures.

The Penrhyn railway is six miles and a quarter in length, divided into five stages. It has three-eighths of an inch fall in a yard, with three inclines, was begun in October 1800, and finished in July 1801.

On this railway two horses will draw twenty-four waggons one stage six times a day, and carry twenty-

four

Page 255.

Fig. 2.

Fig. 1.

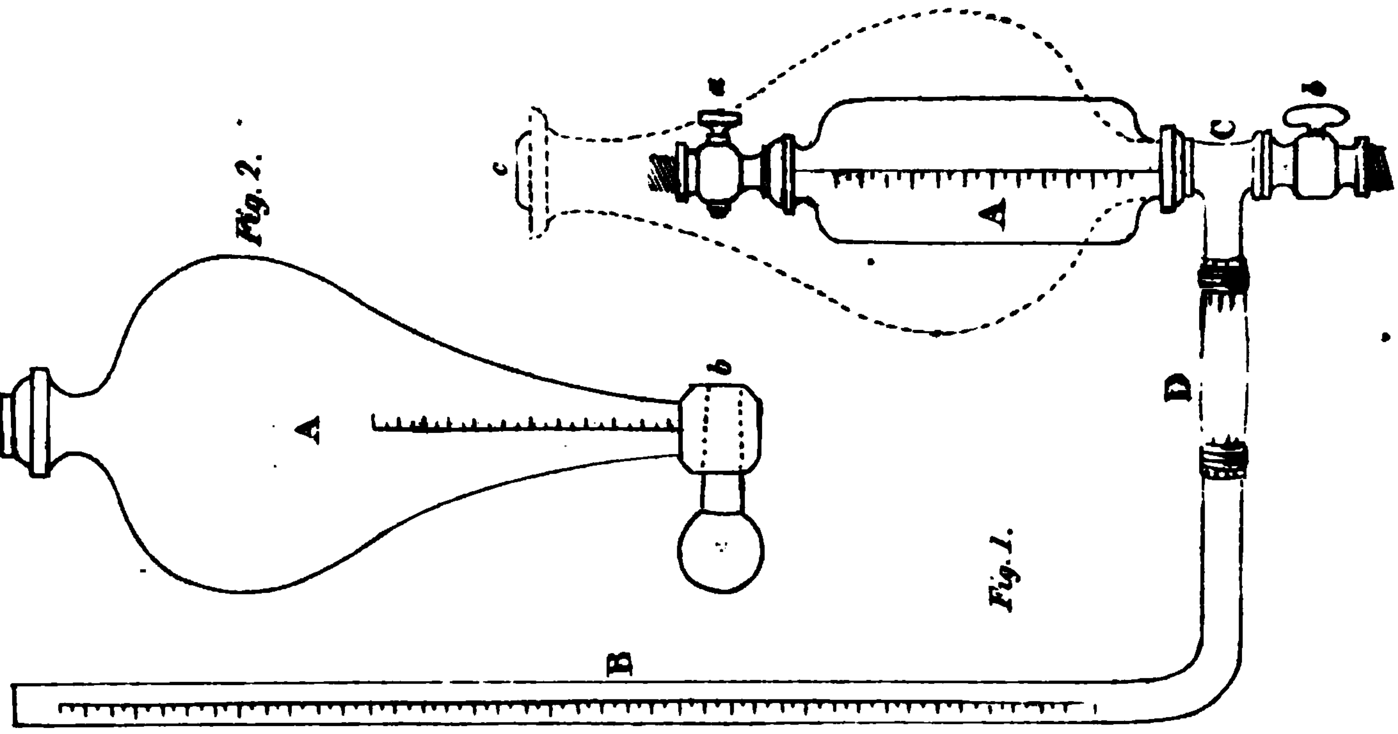
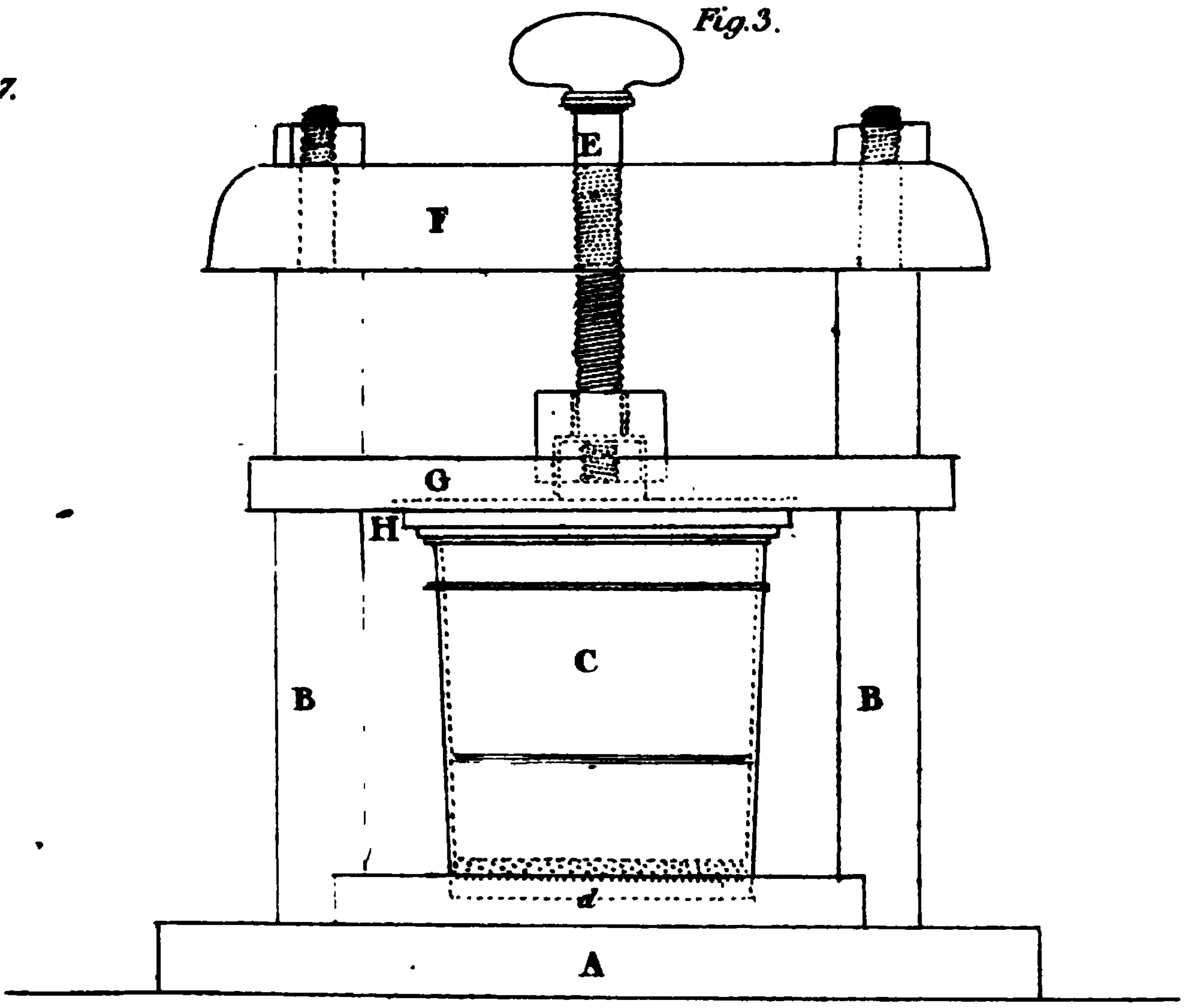
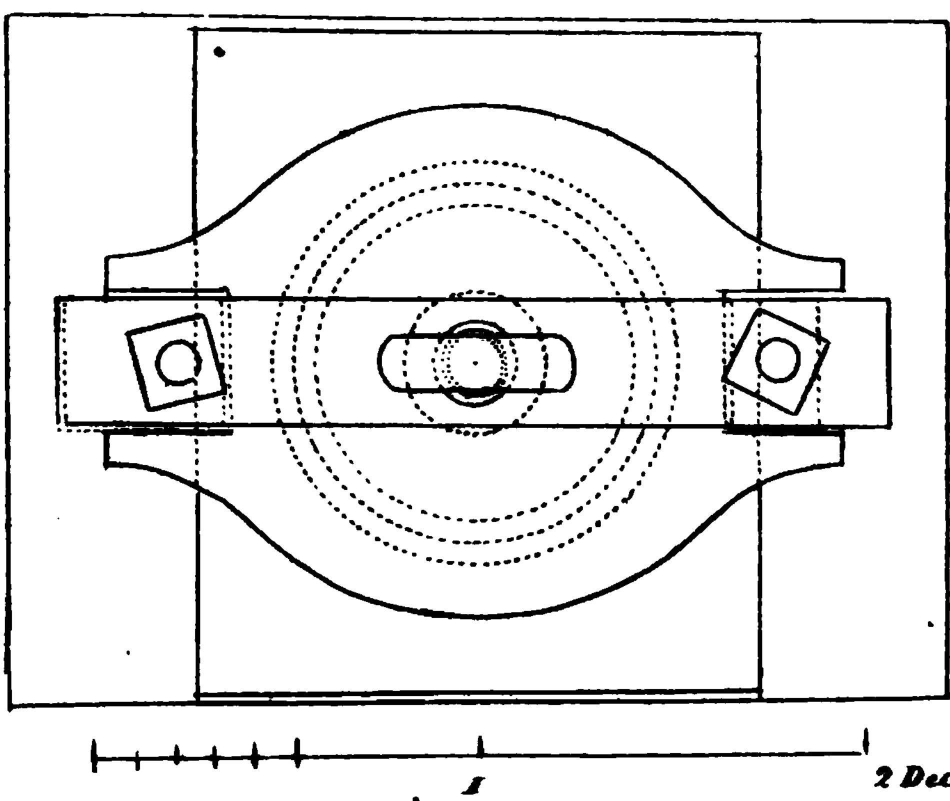


Fig. 3.

Page. 287.



Plan



four tons each journey, which is 144 tons *per* day. This quantity used to employ 144 carts and 400 horses; so that ten horses will, by means of this railway, do the work of four hundred.

I am, &c.

BENJAMIN WYATT.

REFERENCES TO PLATE XI.

Fig. 1, shews the kind of carts used on this railway.

Fig. 2, section of the railway, full size, four feet six inches long; weight thirty-six pounds. The part below the oval is cast to each end of the rail three inches long, to let into the sills, which have a dove-tail notch to receive them.

New Observations on the Use of Acid Fumigations to purify the Air, and stop Contagion; and the most simple Method of producing that Effect. By M. GUYTON.

With a Plate.

From the ANNALES DE CHIMIE.

THE bottles for purifying infected air, and preventing contagion, are become so common, that they may be had ready-made at the shop of M. Boulay. Nothing can be conceived more simple than the method of preparation, more convenient for common use, or less expensive, on account of the property which this composition possesses of preserving its virtue for a great length of time. I have one of these bottles, prepared almost twelve years ago, and which, the moment it is opened, emits a strong smell of oxygenated muriatic acid gas, though it has

has served me on a great number of occasions, and nothing has been added to it since its preparation. Such is the property of what I have denominated extemporaneous oxygenated muriatic acid, because it is made in an instant, without any distilling apparatus, by simple mixture.

Though the operation is in itself so very easy, yet there are nevertheless proportions to be observed, that the disengagement of gas may be sufficiently abundant to be efficacious, and not so rapid as to injure the vessels; and it is obvious that in these cases, that attention should be paid not only to the quantity, but still more to the state of concentration of the acids.

Several persons having seen the stoppers fly out of the bottles of themselves, were alarmed, and mentioned it to M. Boulay; he thought the best mode of correcting this inconvenience would be to dilute the mixture, in order to weaken it. Soon after I was informed that bottles lately purchased emitted scarcely any smell when held to the nose, and was even shewn some that had but a very slight smell of ordinary muriatic acid. In conformity with the advice I instantly gave to M. Boulay, he took precautions that all his bottles should have the necessary degree of strength, and I know that those which he has since sold have been properly made up. These circumstances caused me to think that it might be useful to determine, with greater accuracy than I had yet done, the process, by which I mean the proportious both of weight and bulk, to produce a liquor that may always be regulated at pleasure, and preserve its strength. I shall proceed to give the receipt with all its details.

The bottles to be employed for this purpose should not exceed the capacity of $4\frac{1}{2}$ centilitres, or 45 centimetres, (about $2\frac{1}{4}$ cubic inches). This is the size of those

prepared

prepared by M. Boulay; he fixes them in a case of hard wood, generally box, of neat workmanship. This box shuts by means of a screw. It is unnecessary to observe, that the stopper of the bottle should be of glass ground so as to fit exactly.

When you have selected a bottle, measure its capacity. Supposing it to be 45 cubic centimetres, put into it 3 grammes of black oxyd of manganese pulverized, not reduced to fine powder, but merely passed through a hair sieve. Add 7,5 cubic centimetres, or $\frac{1}{4}$ of a centilitre, (about $\frac{1}{3}$ of a cubic inch,) of pure nitric acid, the specific gravity of which is 1,134, (about 17 degrees of Baumé's arëometer). When the stopper is put in, the operation is finished.

It will be observed, that there remains in the bottle a vacancy of about two-thirds of its capacity; this is a material point, without which it cannot possibly contain the gas. Having once exceeded this proportion in a very strong bottle of flint-glass, of the capacity of 4 decilitres, the stopper weighing 122 grammes was projected to such a height that it broke the bottle in its fall; but by observing the above proportions, all accidents may be prevented.

It would be adviseable to accompany these bottles with a short instruction how to use them, the knowledge of which only gives a value to any object.

It must be premised, that the screw of the wooden case is intended only to keep the glass stopper in its place, which would otherwise be expelled by the expansion of the gases, and would suffer the acid to escape; so that if this screw be turned too far, the top of the case must consequently be split, or the neck of the bottle broken, which would be attended with danger if not immediately perceived.

 I have

I have observed that the first motion of those unacquainted with the nature of acid gases, is to lift the bottle to their noses as they would a common smelling bottle, which produces an irritation the more painful the more speedily it is raised to its maximum. It is therefore of some consequence to inform them, that the bottle should never be held near that organ; that, on the contrary, it should be placed at a distance from it when the stopper is taken out, and that it is time to put it in again when the olfactory nerves begin to be affected by the gas, excepting the fumigation be intended to act in a given space, as in purifying a room infected with putrid exhalations; in which case the bottle is placed on a table, where it is left open for some minutes. With attention to these points, the whole effect is obtained without incurring the smallest inconvenience.

Permanent Apparatus for purifying the Atmosphere of Hospitals, or Places of Public Resort, &c.

In an account of the numerous experiments which I made during one of the hottest summers, on considerable volumes of air infected by putrid matters, I have stated that I took the precaution to keep in my laboratory a very large bottle, containing the above-mentioned mixture, for producing oxygenated muriatic acid gas. This bottle had been left there, and fell into my hands a few days ago, when I was surprised, upon opening it, at the strength of the gas it contained after an interval of two years. I was convinced that this mixture, put in sufficient quantity into larger vessels, might be substituted for all kinds of disinfecting fumigations, and fulfil the object as completely without trouble, expense, inconvenience, or even the necessity of renewing the preparation, if not after too great length

of

of time, and even if the occasions for giving vent to the gas should have been very frequent.

It is plain that the capacity of the vessel must be proportionate to the extent of the space to be purified, and its opening sufficiently large to emit instantaneously the requisite quantity of gas; that is, enough to reach every where without too powerfully affecting those who are nearest to it. It is necessary that the gas should be confined in such a manner as not to escape even imperceptibly, but that its exhalation should be limited to such times and quantities as we please, and remain whole months without its pressure being in the least suspected.

All these conditions may very easily be obtained even for the largest ward of a hospital, by the means I am about to describe.

Take one of the jars, of very thick flint glass, that may be procured in any of the shops, 11 or 12 centimetres in height, and 10 in diameter, of the capacity of 7 decilitres, (about 35 cubic inches). The edge must be prepared to receive a cover formed of a flat plate of glass. The bottom of the jar is fastened to a board, made to slide horizontally in the grooves of two side pieces. These sides support a covering, through which passes a screw that serves to lift off or put down the cover of the jar by means of a nut fixed to a moveable piece.

A reference to Plate XII. Fig. 3, will explain the form and dimensions of this simple apparatus, which may be entirely of wood, without iron or any other metal; the construction is within the comprehension of the meanest capacity, and is far from being expensive.

The vessel being thus disposed, and admitting its capacity to be 7 decilitres, there must be poured into it successively a decilitre of nitric acid, at the degree of

concentration above mentioned, and a dicilitre of muriatic acid; to these must be added 40 grammes of black oxyd of manganese pulverised, and the vessel must be immediately closed by pressing down the cover. These proportions are given on account of the necessity of leaving at least two thirds of it empty.

If the infection is powerful, or if the places from which it proceeds are so numerous as to renew it from time to time, it would be advisable to have two or three of these apparatus in different parts of the ward.

In an apartment of less extent than that here supposed, for instance in one containing only ten or twelve beds, or in places of resort, where the air is vitiated only by a momentary accumulation of animal effluvia, instead of the above vessel, one of those bottles, with a very wide neck, for the use of laboratories, may be employed; their capacity is generally from 40 to 45 centilitres; and their necks are 3 centimetres and upwards in diameter.

It will instantly occur, that by putting into one of these bottles 6 centilitres of each of the two acids and 24 grammes of black oxyd of manganese, a supply of anti-infectious gas is procured in the most simple manner. The only cause of apprehension here, and which is removed by the apparatus, is that the stopper being kept down only by its own weight, might be forced out by the expansion of the gas; but, to prevent this accident, nothing more is necessary than to fasten a lump of lead to the stopper.

The only instruction to be given relative to the manner of using these reservoirs of anti-infectious gas, is to open them when thought proper, and to shut them as soon as those nearest them begin to be affected. The expansion of the portion of gas emitted follows of course, and the effect is such, that if the vessel remains open only

only four or five minutes, those who enter an hour afterwards at the farthest door from it will immediately perceive that there has been a disengagement of oxygen gas.

It will doubtless be admitted, that of all the processes for acid fumigations, this is the most simple, the least liable to accidents, and the best calculated for common use. Every one who considers that the gas thus produced is acknowledged to be the most efficacious even by those who seemed to doubt its activity before the means of regulating it at pleasure were discovered; in a word, every one who adopts the decided opinion of many professional men, that this gas excels all others in the property of exciting the vital powers, must agree with me, that when petty passions are exhausted in opposing the evidence of facts, the superiority of the oxygenated muriatic acid gas, as a purifying and anti-contagious gas, will be established, and that its extemporaneous preparation will be the common prescription for the preservation of health.

References to Plate XII.

A, (Plate XII. Fig. 3,) a flat piece of wood, on which are fixed the two uprights B, B.

C, a glass jar, glued to a small moveable board *d*, which slides into the grooves of the two uprights.

E, a wooden screw, passing through the cross-bar F, and fastened at its extremity to the moveable horizontal piece G, which slides up and down the two upright pieces,

H, a glass plate, serving for a cover, and glued to the lower surface of the moveable piece G.

New

New Process for saturating Potash with Carbonic Acid. By *M.* Curaudau.

From the Annales des Arts et Manufactures.

THE following process for saturating potash with carbonic acid is very simple, and cannot be too widely diffused, as carbonate is so generally employed in the arts. The apparatus and process of M. Welter to saturate potash with carbonic acid, and to procure carbonate of potash of a certain quality, are expensive, and cannot be employed in operations on a large scale. It was with the intention of correcting these inconveniencies that M. Curaudau directed his researches to the means of forming this combination by easy, expeditious, and economical processes.

We shall not here enter into any details on the different purposes for which potash is used; suffice it to say, that the results obtained from it vary according to its greater or less degree of purity, and that in commerce it is difficult to find two samples of the same quality. They differ either in appearance, in the proportions of carbonic acid and the different saline substances intermixed with them, either by nature or art. It is in general very difficult to judge of the quality of potash by mere inspection, and by the taste; for, by trusting to them, the most experienced purchaser is frequently deceived.

It is therefore to be wished, that this substance could be procured in commerce of an invariable degree of purity: the advantages that certain arts would derive from it would soon cause it to be preferred to those crude kinds of potash which very often occasion considerable losses

when

when they are always employed in equal quantity. It must be observed, on this occasion, that the good quality of potash is sometimes as prejudicial in certain operations as that of inferior quality is inefficacious. In the former case it acts too powerfully upon the substances submitted to its action on account of its causticity: and in the latter its effects are so weak that the artist is most frequently obliged to recommence the same operation several times. These inconveniences prove how necessary it is to be acquainted with the nature of substances that are employed, particularly in operations whose results vary according to the greater or less quantity of the same substance.

An additional obligation will be conferred upon the arts by chemistry, if, by means of that science, they can be furnished at a fixed price with the potash they require in such a form, that the purchaser can no longer be deceived.

M. Curaudau hopes that his process may produce this effect. I invite chemists, he says, to assist me in shewing the necessity of introducing into commerce the carbonate of crystallized potash.

The method by which I succeeded in abundantly obtaining carbonate of potash in crystals, is the result of those fortunate applications which chemists are enabled to make by the aid of chemical affinities. This process is too simple for me to make a merit of it as a discovery; I sincerely think that if it has not hitherto been known, it is because chemists have not had occasion to devote to it such serious attention as I have done.

Process.

After dissolving, in a sufficient quantity of boiling water, as much potash as is necessary to saturate it, incorporate

porate with it dried tan * till all the liquid is absorbed, and till the mixture resulting from it appears pretty dry. Fill a crucible with this composition, cover it with a lid, and lute the interstices.

This crucible must be submitted to the action of a reverberating furnace about half an hour, or till it is red-hot: when the crucible is cold, pour upon a filtre all the matter contained in it, levigate it with a sufficient quantity of water to purify it quickly; afterwards evaporate the liquor to a very small quantity, and after it has been left to cool about twenty-four hours, it will furnish very beautiful crystals of carbonate of potash †.

When the evaporation has been continued rather too long, and in operations on a large scale, the crystallization begins at 20 or 25 degrees of heat; which proves that evaporation is a method of obtaining this saline substance in very large masses, and regularly crystallized. The figure of these crystals varies, according to the greater or less degree of concentration of the ley, and according to the circumstances attending its cooling. A quantity of ley, evaporated to a pellicle, and cooled according to the principles of crystallization, furnished quadrangular pyramidal crystals, the points of which were extremely sharp, and whose base was covered with other crystals, in the form of a lozenge. These crystals, submitted to the contact of the air, attract a small degree of humidity.

* I mention tan, because it is the most common and least expensive material: bran, saw-dust, and charcoal-powder, afford the same results.

† I must observe, that it is infinitely more advantageous to perform the operation on a large than on a small scale; the rapidity with which small quantities cool, frequently prevents the formation of regular crystals.

After

After all the carbonate which the ley held in solution has been obtained by several evaporations and crystallizations, the mother water may be submitted to calcination with tan, and by this second operation a fresh quantity of crystals of carbonate of potash will be obtained. As it frequently happens that the liquor at length becomes more surcharged with other salts than with potash, it may be evaporated to dryness, and the residue may be employed in making nitrate of potash.

Theory of the Process.

The theoretic part of this operation agrees exactly with what is already known concerning the phenomena of the decomposition of water; and indeed, when the mixture has acquired sufficient heat to decompose the water which it still retains, abundance of carbonic acid is formed by the immediate combination of the oxygen of the water with the carbonate. It is under these circumstances that the potash becomes saturated with carbonic acid; which, at the moment of its formation, comes in contact with every particle of the alkali. While this takes place, a great quantity of hydrogen is disengaged, and is seen to burn round the interstice between the crucible and the cover.

Experiments on the Substance vulgarly called Gum Kino. By M. VAUQUELIN.

From the ANNALES DE CHIMIE.

THE appellation given to this substance does not at all agree with its nature, and it could scarcely be conceived why it should be called gum if it were not almost always the case, that objects receive names before they are known; for it possesses neither the physical nor the chemical properties of that substance.

We do not yet know for certain what country and what kind of tree produce the gum kino. The English brought it to Europe, and made it an article of commerce by announcing its medicinal properties.

It is called in trade the *kino*, or *gum resin of Gambia*. It was pronounced to be real gum senegal by Dr. Oldfield, who made the celebrated Dr. Fothergill acquainted with it. But, in the *Medical Observations and Enquiries*, we find that the tree which yields the gum kino is called by the natives of the country *Pau de Sangue*, and that it is brought hither from Africa.

It is employed in medicine under the form of boluses and lozenges, composed of sugar, infusions of water and alkohol, as an astringent and tonic medicine for weakness of the stomach, flux, dysentery, and obstinate diarrhœa.

Gum kino has a colour which appears black when seen in a lump, but it is actually a reddish brown; its taste is bitter and astringent, and it has scarcely any taste. It is brittle, and may be reduced to powder; its fracture is smooth, resembling that of glass, and it becomes rather soft by the warmth of the hands.

When

When submitted to the action of fire it is rendered liquid, and bubbles considerably: it yields at first a clear liquor, but which appears coloured in a few moments; it is then converted into a white light oil, which acquires a colour in the course of the operation, and becomes heavier than the aqueous product. By this decomposition of the gum kino a small quantity of carbonic acid and much carbonated hydrogen gas are formed.

The oil resulting from this operation unites with caustic fixed alkalis, and produces a dark red liquor, which becomes of a dull green in the air.

The aqueous product is not acid, it has a sharp and acrid taste, arising from a portion of oil, which it holds in solution; the potash likewise separates from it a great quantity of ammoniac, which is probably united to the carbonic acid.

1. Out of twenty grammes of this substance, distilled by a powerful heat, were left eight grammes and a half of charcoal of great bulk. This charcoal, when incinerated, produced seventy-two centigrammes of ashes, formed principally of lime, silica, alumine, and oxidated iron.

2. Gum kino is but little inclined to dissolve in cold water, but is much more so in hot; yet even in this there is a portion which does not dissolve, and of which I shall speak presently.

3. The solution of gum kino is slightly acid; for when it is sufficiently diluted with water, and tincture of turnsol is gently poured upon it, you see it turn red as fast as it mixes. The alkohol does not precipitate this solution, but only separates some reddish flakes.

When made with boiling water, it becomes turbid as it grows cold, like a decoction of quinquina; the matter which it deposits is of a reddish brown.

4. This solution, a little concentrated, is abundantly precipitated by alkaline carbonates, but the precipitates may be again dissolved by a great quantity of water.

It is likewise precipitated by caustic alkalis, and an excess of those matters redissolves the sediment, and at the same time gives it a more solid red colour.

5. Animal glue, dissolved in water, forms a very considerable coagulum of a rose colour, in the solution of gum kino; if a sufficient quantity of those matters has been employed to saturate each other, the liquor above the precipitate remains almost colourless.

6. Though these effects seem to indicate presence of tannin in gum kino, yet it does not precipitate ferruginous salts black, but, on the contrary, of a dark green, which is not sensibly affected by the air.

This property gum kino possesses in common with infusions of quinquina and rhubarb, from which it appears probable that those three substances contain a principle of the same nature.

Be this principle what it may, it is of a very destructive nature; for, if you pour upon the precipitate which it forms with iron a small quantity of oxygenated muriatic acid, it loses its colour, is dissolved, and is not restored by the addition of an alkaline carbonate; you have then only a red oxyd of iron.

7. The solution of gum kino abundantly precipitates acetite of lead of a yellowish-grey colour, nitrate of silver of a reddish yellow, and that of antimony of a yellowish white, but in much greater abundance than infusions of tan and of quinquina, which appears to shew that it would be a better antidote in cases of poison by that metallic salt.

8. Concen-

8. Concentrated sulphuric acid precipitates the solution of gum kino in great quantity: in proportion as the mixture grows cold the matter combines in a tenacious and ductile mass, which resembles a resin mollified by heat. This effect takes place almost in the same manner in an infusion of gall nuts, into which has been poured sulphuric acid.

Nitric acid likewise forms a precipitate, but in much less quantity than sulphuric acid.

It is rendered turbid by oxygenated muriatic acid, and a pellicle is formed on its surface, which in a little time acquires a very firm consistence.

9. As solution of gum kino forms, as we have seen above, a green precipitate with iron, I was desirous to ascertain whether it would dye stuffs that colour. To this end I boiled wool and cotton in this solution, and afterwards plunged them into liquor of sulphate of iron. At the moment of their immersion they assumed a bottle-green colour; but, by washing and desiccation, this colour changed to a blackish brown: it is very solid.

10. Heated alcohol very easily dissolves gum kino; the solution is dark brown, is rendered rather turbid by water, but forms no precipitate. There is however a small quantity of matter which remains undissolved, and of which I shall speak in the sequel.

11. The solution of kino in alkohol, diluted with water, produces, with re-agents, the same phenomena as the solution in water; namely, with iron a green precipitate, and a white one with silver, lead, and antimony; which proves that the principle which determines these effects is soluble in water and in alkohol.

12. The mixture of gum kino and alkohol, evaporated to dryness, leaves a black, dry, and brittle matter, of which

which water dissolves but a small portion: boiling water likewise dissolves much less of it in proportion than of the entire gum. We shall see farther to what cause this difference is owing.

13. When the alkohol appeared to dissolve no more of the gum kino, with the assistance of heat, I submitted the residue to some experiments to ascertain its nature; it formed almost one-fourth of the gum that had been used.

1. It had no bitter nor astringent taste like gum kino; it was on the contrary mild, and appeared to be mucilaginous. 2. It dissolved readily in hot water, and communicated to it a beautiful red colour. 3. It was not precipitated either by glue or any metallic solution, but it was by alkohol. It had therefore been deprived by the alkohol of the matter which produces the effects noticed above.

4. This matter in burning emits a smell similar to that which proceeds from gums treated in the same manner; from which it appears to be of the nature of gum, but it differs from common gums in the red colour, of which alkohol cannot deprive it.

I suspect that the presence of this substance in gum kino promotes the solution in water of the principle which is soluble in alkohol; for the latter, separate, appeared to me much less soluble than when it is mixed with the gummy part; and, on the other hand, I observed that if the quantity of hot water necessary for the solution of the astringent part be not employed at once, the remainder requires a larger quantity in proportion of that fluid.

For 100 grammes of gum kino I took above 4 litres of water, at different times, without being able to dissolve it intirely;

intirely; there remained about 20 grammes, or ⅕. This residue became soft with the heat of boiling water, like a species of resin, which is not the case with the intire gum.

A great part was dissolved by alkohol, to which it communicated a red colour, and all the properties which we have already found in the astringent matter.

After thus treating the gum kino with water and with alkohol, there remained only 7 decigrammes, which however were not entirely exhausted of vegetable matter; for alkalis extracted from it a very beautiful and very deep red; and, on the other hand, in burning it emitted an acrid smoke, almost like that of wood. After combustion it left some reddish ashes, composed of silica, lime, and oxyd of iron.

14. Sulphuric acid, diluted with a large quantity of water, and aided by a gentle heat, reduces gum kino to a ductile pitch-like substance, the liquor is of a red colour, but clearer and more lively than that of the aqueous infusion of gum kino. Thus it appears, that instead of augmenting the dissolving power of water, the sulphuric action on the contrary diminishes it; for, if alkali be poured into this liquor, it forms no precipitate. Thus this substance differs from the resinous portion of quinquina, which is much more soluble in acidulated than impure water, and is afterwards precipitated by alkaline carbonates.

Upon the matter, thus treated with diluted sulphuric acid, were formed, in the course of a few days, a great number of small crystalline needles, perfectly white, which, upon examination, exhibited all the properties of sulphate of lime. Thus, there is some portion of lime in this vegetable matter.

As

As the solution of gum kino abundantly precipitates the solution of glue, and as it appears to possess a great number of other properties analogous to those of tannin, I was desirous of trying whether skins might be tanned with it. I therefore prepared a piece of ox-hide in the usual manner, put it into a weak solution of gum kino, and left it there eight days.

I soon perceived that the colour of the solution lost its intensity, and that the colour of the skin became darker in the same proportion. I likewise remarked, that the solution had become turbid, and had deposited a great quantity of yellow flakes. This effect I imagine must have been produced by a remainder of sulphuric acid with which I had swelled the skin, and which had not been carried away in washing.

When the action of the skin upon the solution appeared to have ceased, I put it into another portion, stronger than the former, in which I left it twenty days. At this period the skin had acquired a dark fawn-colour; and, when cut, it might be seen that the tannin had already penetrated above a line in depth. It had likewise acquired great firmness and consistence; it was no longer soft and semi-transparent, as when first put in.

Conclusions.

From what has been stated in this notice concerning the properties of gum kino, it appears that this substance is in a great measure composed of tannin, and is not a gum, as some have supposed, nor a gum-resin, as others have imagined.

If this matter should become more abundant and cheaper, it might therefore be employed for those purposes for which the vegetables called astringent are used.

I must

I must, however, observe, that there is a great difference between its tannin, and that contained in gall-nuts and oak-bark, because the latter precipitates solutions of iron of a black-blue, while, on the other hand, the solution of gum kino precipitates them green; a colour which, when applied to stuffs, changes to a blackish brown by contact with the air. It bears a much greater resemblance to that found in quinquina and rhubarb, for the infusion of those substances likewise precipitates iron green.

New Process for making artificial Alum without the Assistance of Evaporation.

By M. CURAUDAU.

From the ANNALES DE CHIMIE.

MESSRS. Guyton and Vauquelin made a report to the National Institute in Fructidor, year 9, (Sept. 1801,) on a new process, by M. Curaudau, for making artificial alum. As this report is not generally known, we are the more desirous to communicate it to our readers.

For the making of alum, M. Curaudau proposes to employ 100 parts of clay and 5 of muriate of soda, dissolved in a sufficient quantity of water to give the mixture the consistence of paste. It is then made into cakes, and put into a reverberating furnace, in which a strong fire is maintained for two hours, or till the interior of the furnace begins to be red-hot. When the calcination is completed, and the clay is reduced to powder, it is put into a good cask, and a quarter of its weight of sulphuric acid is thrown upon it at several times, stirring it well each time. When the vapours of muriatic acid, which are

 thus

thus disengaged, are dissipated, the same quantity of water is then added as of sulphuric acid, and it is stirred as before. Such an expeditious combination ensues between the acid, the earth, and the water, that the mixture becomes hot, swells, and exhales very abundant vapours. At length, when the heat is somewhat moderated, more water must be added till there is about eight or ten times as much as of the acid.

The earth not serviceable for the formation of the alum being deposited and the liquor clarified, it is drawn off into leaden boilers. Then pour upon the sediment a quantity of water, equal to that of the liquor drawn off; this is added to the first. Lastly, mix with these leys a solution of potash, which must contain as much of that alkali as is equal in weight to a fourth part of the acid employed, and stir it. If the sulphate of potash be preferred, take twice as much as of alkali.

After some time the liquor, as it cools, forms crystals of alum; the quantity of which, when the crystallization is completed, amounts to three times the weight of the acid employed. This alum is refined by dissolving it in the smallest possible quantity of boiling water, and it is then as fine as the best alum of the shops.

As the sediment still retains some saline particles, M. Curaudau recommends to levigate it a third time with a sufficient quantity of water to extract the whole of the salt, and to employ this liquor instead of pure water for the second operation; by these means nothing is lost.

Thus the greatest part of the alum formed in the operation is obtained without any aid from artificial heat, which is an important advantage. The author advises the employment of the mother waters, which still contain alum and highly oxydated sulphate of iron, for the manufacture

manufacture of Prussian blue, for which they are extremely proper.

He considers the making of alum as particularly advantageous for the makers of Prussian blue, as they might calcine their clay at the same time with their animal matters without any augmentation of expense. They would have no occasion to add potash to it, and the presence of iron, instead of being prejudicial, would on the contrary prove extremely useful. If they even wished to manufacture alum for commerce, they might employ, in order to dissolve the mixture of alumine and sulphuric acid, instead of water, the solution of sulphate of potash arising from the levigations of their Prussian blue, of which in general no use is made. They might likewise employ for the same purpose distillers lime-rubbish, which contains alumine and potash proper for making alum. It would be sufficient to sprinkle that substance, reduced to powder, with sulphuric acid, and to add to the mixture the necessary quantity of water, proceeding as above directed. The mother waters of this kind of alum would likewise be useful for the making of Prussian blue.

It must be observed, that distillers lime contains more alkali than is necessary for the saturation of the sulphate of alumine formed by the clay, and that to extract all the virtue from that substance an eighth part of that earth calcined according to M. Curaudau's process should be added; and, by employing about 60 parts of acid to 100 of earth, at least 180 parts of very fine alum would be obtained.

By these different processes M. Curaudau declares that he has long made alum 25 *per cent.* better than that of the shops; and that, notwithstanding the low price to which that article has now fallen, he still has a profit of

10 or 12 *per cent.* upon it. He likewise says, that the manufacturers of Prussian blue, to whom the potash would cost nothing, would, even at the present time, obtain a profit of 17 or 18 *per cent.* from the artificial manufacture of this salt.

From the contents of the above report, it will be seen that M. Curaudau's memoir contains the result of facts and experiments made on a large scale, of great importance to manufacturers and commercial men, and on this account it appears highly proper to diffuse it.

Transactions of Societies for promoting useful Knowledge.

Economical Society of St. Petersburg.

AT a late meeting of this Society, the prizes for this year were distributed. M. Nau, professor at Aschaffenburg, received the first prize for having produced the best mechanical apparatus for churning.

A large silver medal was adjudged to M. Rauschenplatt, junior, watch-maker, of Gottingen, for the next in merit.

To M. Wiese, tobacconist, at Pernau, a silver medal was decreed for a treatise on improvements in the culture of tobacco in the Ukraine.

Society of Agriculture and Commerce at Caen.

This Society last spring resolved to invite the artists and manufacturers of Calvados to exhibit such of their productions as were most interesting to the arts and commerce, in a place prepared for that purpose. The prefect

fect approved of this patriotic plan of the Society, and on the 25th Germinal (15th April) the hall of exhibition was opened to the public, who saw with satisfaction the multitude of curious and valuable objects produced by the industry of the town of Caen, and the department in general.

On the 25th of April the Society met in the same place where the exhibition had been held. Nine silver medals were distributed among those artists and manufacturers who appeared to the judges to deserve distinction or particular encouragement.

One was given to the inventor of an artificial leg, to replace the loss of a leg or thigh. This contrivance is at once simple and solid. The motions of the knee and foot perfectly imitate those of nature: in a word, the whole is an exact imitation of the natural leg.

A gun-maker obtained another, for the great number of workmen whom he continually employs.

A tanner received the same encouragement. Two lace-weavers attracted the attention of the judges; one for having executed a robe and tunic in very beautiful lace; the other, M. St. Jaure, for his admirable patterns, and the uniform beauty of his work.

Medals were likewise decreed to the porcelain manufactory, which successfully rivals all the others in France; to a manufacturer of Lisieux, and a citizen of Falaise; to the latter, for having introduced into the department the manufacture of a particular kind of handkerchief. The last was adjudged to a stocking-manufacturer, for the good quality and beauty of the articles produced by him.

Society of Grenoble.

From a memoir on the commerce with hackled hemp, read to the Society of Grenoble, by M. Berriat de St. Prix, it appears that the prime cost of a quintal of raw hemp is 50 francs; that when it is wrought it is worth 81 francs; from which must be deducted the interests of money advanced to the workmen and cultivators, and the credit given to purchasers. The same memoir shews that the commerce in hemp had increased very considerably in France within the last century; that Grenoble contains three hundred workmen, each of whom can prepare 60 quintals of hemp *per annum*, making a total for that town alone of 18,000 quintals.

Society of Agriculture of the Department of the Ardennes.

The Society of Agriculture, Arts, and Commerce, of this department, which meets at Mezieres, has just published the fourth part of its collection of Select Memoirs. It contains, among other interesting pieces, a dissertation on the propagation of pulpy fruit-trees in some of the cantons of the department; reflections on inundations, which are very frequent there, and on the means of preventing their disastrous effects; a report on a new plough; and several other papers; which evince the intelligence and zeal of that Society.

Athenæum of Arts at Paris.

The Athenæum of Arts held a public meeting on 11 June, under the presidency of M. Dessessarts, in the absence of General Berthier.

The secretary delivered an account of the most important transactions since the last meeting.

M. Rondelet read a fragment of a work on the construction of the vessels of the ancients, particularly gallies,

lies, with several rows of oars: and, in the inclination of the benches of the rowers, he has discovered the solution of a problem which has puzzled all the antiquaries and ship-builders.

M. Bernard gave a description of a penknife, with a scale, graduated in such a manner as to afford the advantage of giving a constant and regular inclination to the nib of the pen.

M. Salivet entered very minutely into the details of a new copper-plate printing-press, with copper rollers and continued movements, which give a great equality to the impressions, and permit a greater number to be taken off without any new arrangement of the press. For this improvement the inventor, M. Frappée, was presented by the president of the Athenæum with a gold medal.

M. Lecamus described M. Dellebarre's new microscope. Not contented with the degree of perfection he had given to that instrument thirty years ago, that artist has succeeded in augmenting its effect and facilitating its use; the Athenæum therefore decreed the venerable old man the maximum of its rewards, the crown and a medal.

A new lyre, with seven strings, by M. Morlane, was described by M. Famin; and the president rewarded the maker with a medal of encouragement.

Society of Agriculture of Boulogne.

On the 28 April, 1803, the Society of Agriculture, Commerce, and Arts, held its fourth public meeting.

The secretary presented a report of the labours of the Society since the last public meeting; after which he read a report from the commissioners appointed to examine a report presented for competition on the question relative to marls, proposed last year. It was not considered worthy

worthy of the prize, which was continued for the year 1804.

M. Isnardy then read a memoir on oxygen; in which, after presenting an historic sketch of the experiments which led to the discovery of oxygen gas and its properties, he enters into a detail of the applications which have been made of it to animal and vegetable physiology. He explains, with equal perspicuity and accuracy, the admirable phenomena of respiration, the circulation of the blood, and digestion: he shews the effects of oxygen in these different functions, presenting an interesting analysis of the experiments of Bichat. He then examines all the uses to which oxygen may be applied in the healing art, either to discover the nature of the air we breathe, to purify it, to prepare an air suitable for a patient labouring under this or that disease, or as an antiseptic in all disorders, internal or external, for which metallic oxyds are employed. He invites chemists to seek an easy and economical method of obtaining oxygen gas, and likewise processes to which every one might be capable of recurring, according to circumstances.

The sitting concluded with announcing the questions proposed for the subjects of the prizes to be decreed in the next public meeting, on 28 April, 1804.

1. It is generally acknowledged, that the practice of Marling is one of the most important improvements in agriculture. The Society will grant a prize to the memoir which shall best develope the nature of marls, their different kinds, and the methods of employing them to the greatest advantage, according to the nature of the soil. The author must principally confine himself to point out to farmers such exterior characters as will enable them readily to distinguish each kind of marl.

2. Sheep

2. Sheep are subject to a disease called staggers. The number of animals which perish by this malady may be computed at 3 or 4 in 100 *per annum*. Thus, if France contain 30 millions of sheep, the number which are carried off by this disease may be estimated at 900, or 950,000. This disease is occasioned by a bag, formed in the head of the sheep, containing an extremely limpid water and a white substance, divided like seed, and which, by the microscope, is discovered to be actual worms. It appears that, to cure this disease, it is necessary to open the head of the animal, and to extract this bag; but the operation appears so critical, and has hitherto been attended with such ill success, even at the Veterinary School of Alfort, that the Society has judged it to be of great utility to agriculture to propose a prize for him who shall point out the best method of treatment for the staggers in sheep, and how to cure them perfectly of that disease. He must be careful to support his processes, by properly authenticated experiments.

The prizes will consist of medals, to be delivered by the Society at its public meeting next year.

Galvanic Society, Paris.

On 28 May this Society, for the second time, performed experiments on a large scale, under the direction of its president and professor Aldini, at the Veterinary School of Alfort.

Animals of every size, from the insect to the horse, were subjected to the power of an apparatus of above 2000 disks, disposed in piles, communicating with each other.

Among other results, the following were remarked.

1. That the spark cannot be obtained as in ordinary electricity by explosion at a distance, but only at the point of contact.

2. That the electrometrical balance of Coulomb does not shew the electric tension in proportion to the number of couples and the force of the piles.

3. That it requires all the force of a formidable apparatus to kill a very small animal.

4. That Galvanic applications may determine, after death, the motions of inspiration and expiration. This was proved by holding a lighted taper to a small aperture, made in the tracheal artery of a horse, a quarter of an hour after death. At the moment of applying the Galvanic fluid, the flame was drawn inwards by the precipitation of the air into the lungs, and was blown from the aperture and extinguished when the fluid left the animal.

5. That contractions of the head and trunk of any animal may be produced by placing them at very great distances, and making them communicate with the pile by a single conductor, the other being formed by the common reservoir.

Central Committee for propagating the Cow-pox at Paris.

This committee has just published the general report of its labours for three years. It contains both the theory and practice of the new inoculation, so as to be capable of serving as a guide to those medical men who turn their attention to the subject. The minister of the interior, to whom the committee addressed the report, expresses his warm approbation of their labours, and also of the idea of opening a new subscription for the extinction of the small pox by the propagation of the vaccine pock. He patronizes this philanthropic design, and has subscribed the sum of 2000 francs for putting it in execution.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Phosphorus.

SOME of the German physicians have recommended the internal use of phosphorus in certain diseases. From the experiments made upon various animals by the Academy of Arts, Sciences, and Belles Lettres, of Turin, it appears that this substance, introduced into the intestines, takes fire, and is attended with very dangerous consequences.

Oxygenated Muriatic Acid.

M. Potel, of Dijon, some time since announced that oxygenated muriatic acid possessed the property of restoring drowned animals to life. M. Trannoy, of the Society of Emulation of Amiens, has proved, by numerous experiments, that this gas, instead of producing such an advantage, was of a suffocating nature, and could not but be very dangerous in cases of asphyxia.

New Vegetable Oil.

In the departments of Landes and L'Heraut, in France, an oily plant, called *Arachis*, of the family of lentils, *(Arachis Hypogæa,)* begins to be cultivated. It was brought by the Spaniards from Mexico, and was introduced by the French from Spain. An ounce of the oil of this plant, with a wick, a line and a half in diameter, burned nine hours twenty-six minutes. An ounce of olive oil, under similar circumstances, lasted only eight hours. Thus the oil of the arachis has the advantage of above one-eighth over olive-oil; and more or less over

every other kind of oil. It is an excellent substitute for olive oil for every other domestic use. It is preferable to all other sorts for the manufacture of soap. The seed yields nearly half its weight of oil.

Manufacture of Cloth.

The minister of the interior, the counsellors of state Crelet and Regnauld, Messrs. Conté and Molard, mechanicians, and Messrs. Ternau and Decretot, manufacturers, have lately inspected some machines, made by Mr. Douglas *, for the manufacture of cloth, under the superintendance of the committee of the Society for the Encouragement of Arts and Industry. They found at work four very perfect machines, for the following purposes:

1. A machine for scribbling wool, which scribbles 70 lbs. of Spanish wool in an hour. It requires only a force equal to that of two men, and a child to supply it with wool.

2. A machine for mixing the colours and scribbling. This machine mixes 40lbs. of Spanish wool *per* hour, and scribbles the same quantity. It requires a force equal to that of one person only, and a child to supply it.

3. A machine for raising the nap for shearing. This machine, worked by one man and a child, prepares a piece of yard-wide superfine cloth for shearing in two hours, and requires a force equal to that of an ordinary horse. It is equally suited to all cotton stuffs which require being raised, particularly coverlids. This machine performs two operations. The combs may be taken

* We have good reason to believe that this person is an Englishman, who was some little time since engaged in a similar manufactory in the neighbourhood of Lambeth, where we understand he was unsuccessful.

away;

away; and twelve brushes, to brush the cloth before it is pressed, may be fixed in their place.

4. A loom, with a fly-shuttle, and all its parts complete, worked by one person, placed in the middle.

Ingenious Application of Iceland Crystal to Telescopes.

Iceland crystal is known to possess the property of double refraction, and of giving two images. Of this M. Rochon has very ingeniously availed himself by placing a prism of this crystal in the inside of a telescope, which produces two images of the object observed, and these images are nearer or farther from each other according as the prism is more or less distant from the eye. If a ship be perceived at sea, which you have an interest in overtaking or avoiding, bring the two images in contact; if you are approaching the vessel the two images will gain upon each other; on the contrary, if the two vessels are removing to a greater distance from one another, the images will soon be perceived separate. It is easy to distinguish the rate or class of the vessel observed, and you will know nearly the dimensions of the mast. Bring in contact, end to end, the two images of the main-mast, and you will find how many masts length you are distant at the time from the vessel. By land you observe the images of a body of enemies, place the images so that the feet of one shall be on the head of the other; and if the average height of a soldier be computed at five feet six inches, the telescope will shew you how many times that length is contained in the distance which separates you from the enemy. This sketch is sufficient to explain the utility of an instrument which would be very interesting if it were only considered as an object of curiosity. The experiments with it were repeated at

St.

St. Cloud, 11 Prairial, (31st May,) in the presence of the First Consul, who ordered several telescopes of this kind to be made.

This discovery may also be of great use in astronomy. M. Rochon has already employed it to measure the diameters of Mars, Jupiter, and Saturn. He could not at first apply it to the sun and moon, the diameter of which is about 30′, because the angle of refraction is only 20; but, by an ingenious method of cutting the crystals, Messrs. Rochon and Torelli di Narcy have doubled and trebled the angle of refraction; so that there is not now any planet whose diameter cannot be measured, if it be but sufficiently luminous; for it is obvious that the two images must be weaker than only one would be. But this inconvenience cannot be felt with regard to the sun and moon, which always diffuse too much light. One of these prisms will soon be adapted to the best telescope in the National Observatory.

Portsmouth Canal.

The estimates of the expense of the execution of the intended London and Portsmouth canal, and of its probable revenue when finished, being now perfected, it appears that the cost of the execution will be 721,000 *l.* and that the revenue will exceed 100,000 *l. per annum.* At a late general meeting at the Crown and Anchor, it was unanimously voted to open a subscription immediately for raising a capital of 800,000 *l.* in shares of 100 *l.* each, and to proceed to parliament for an act to carry the measure into effect. As this measure appears to us to be an important national object, we have subjoined an extract from Mr. Rennie's Report upon it.—He concludes his report thus: "When, therefore, the extent of country through which this canal will pass is considered; the communications that will sooner or later take place, not

only

only with those navigations already made, but with others now in contemplation, and likely soon to be made; the abundance of ship-timber there is in the counties through which it will pass; the communications that will be opened with London, and with his Majesty's dock-yards at Portsmouth, Chatham, Woolwich, and Deptford, the city of Chichester, and the numerous towns and villages situated near to it; the various articles of traffic which must be carried between London and these places, and the local trade they will have with each other; the quantities of timber, naval and military stores, which must be carried to and from his majesty's dock-yards, without being liable to the hazards of the sea, and uncertainty of the voyage, or risk of being taken by the enemy's cruizers: the quantities of goods which will be sent by the East India Company to their vessels when lying at Spithead; the immense quantities of chalk, from the inexhaustible chalk-pits bordering on the line, for manure; the quantity which will be wanted in London for lime, which is of an excellent quality, the quantity of coals, &c. &c. I say, taking the whole of these into consideration, I think this is one of the most important lines of inland navigation which have come under my observation."

List of Patents for Inventions, &c.

(Continued from Page 240.)

JAMES ROBERTS, of Abbotston-Farm, Southampton, Yeoman, and GEORGE CATHERY, of New Alresford, in the same county, Gentleman; for a method of compleatly and effectually eradicating smut from wheat; and that wheat, when cleansed by their invention, will produce flour

flour of as good quality and value as flour made from wheat of the best growth. Dated July 6, 1803.

JOSEPH MANTON, of Davies-street, Berkeley-square, in the parish of St. George, Hanover-square, Middlesex, Gun-maker; for a hammer, upon a new construction, for the locks of all kinds of fowling-pieces and small arms. Dated July 6, 1803.

JAMES STUARD, of London-street, in the parish of St. Dunstan Stepney, Middlesex; for a method to strengthen ships or floating vessels. Dated July 27, 1803.

JOHN NORTON, of Rolls-buildings, Fetter-lane, Fleet-street, London, Mathematical Instrument-maker; for an improvement in the construction of a water-mill. Dated July 28, 1803.

THOMAS KENTISH, of Baker-street North, Portman-square, Middlesex, Esquire; for a dewick, for the purpose of more expeditiously, with less labour, and at less expense than heretofore, loading and unloading ships and vessels, removing heavy bodies in any direction, and which is also applicable to other useful purposes. Dated July 29, 1803.

ARTHUR WOOLF, of Wood-street, Spa-fields, Middlesex, Engineer; for an improved apparatus for converting water or other liquid into vapour or steam, for the working steam-engines, for the heating of water or other liquid employed in brewing, distilling, dying, bleaching, tanning, and other processes connected with arts and manufactures; calculated also to make a stronger extract than can be obtained by the processes commonly in use from a given quantity of any vegetable or other substance from which extracts are or may be made without the danger of burning, scorching, or singeing, such vegetable or other substance, and applicable to various other pocesses. Dated July 29, 1803.

Fig. 2

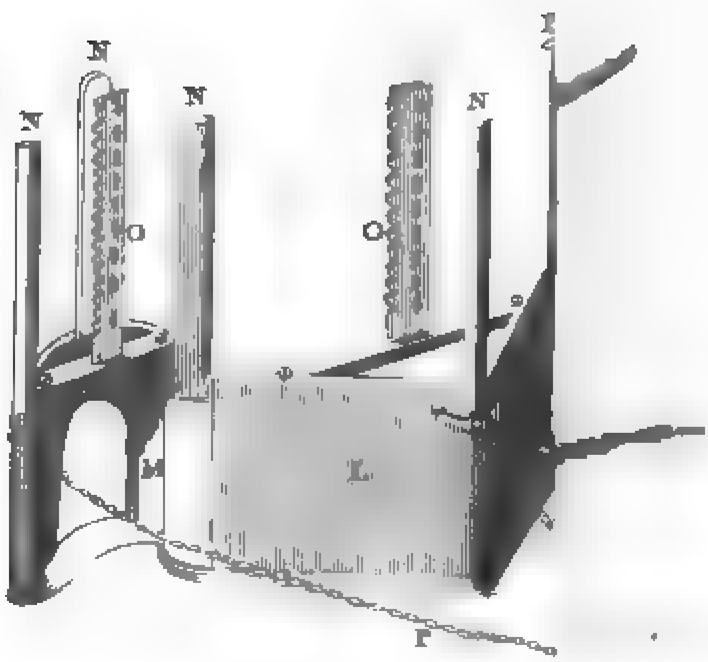
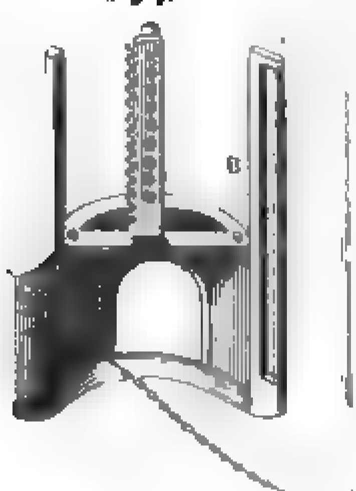


Fig. 4.



THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XVII. SECOND SERIES. OCT. 1, 1803.

Specification of the Patent granted to GEORGE BEAUMONT, *of South Cross Land, near Huddesfield, in the County of York, and* WALTER BEAUMONT, *of the same Place, Manufacturers of Woollen Goods; for a Mixture to be used in the Preparation of Sheep or Lambs' Wool for various Parposes.* Dated May 17, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, we the said George and Walter Beaumont do hereby declare, that our said invention is described in manner following; that is to say: Our mixture consists of oil united with or diffused in water, by means of an alkaline substance, namely, potash, or pearlash, or soda, or the volatile alkali called ammonia, but we give a decided preference to potash or pearlash. The proportions and manner of making the said mixture are the following: Dissolve the best potash alkali in the water, in the quantity of about twelve ounces of alkali, in each gallon of

water; and, when the solution is completed, two measures of the same, or thereabout, are to be added to one measure of the oil, and united by stirring or agitation; and the three measures of compound liquor, thus produced, do constitute and form our said mixture, and will be found to produce the effect of oil when applied in the same manner as oil is commonly used in manufacturing cloths, coatings, kerseymeres, blankets, and every other description of woollen goods.

No instructions are necessary to be given with regard to the oils, or the method of applying the mixture, or the quantity of the same to be used with wools of various qualities and colours, because the oils may be of any kinds suitable to be used with wool, and the operations must be governed by the usual skill and judgment of the workman.

Now farther, we do hereby state and declare, that although the description here given is a true and full specification of the practice or method of making and using our said mixture, we do nevertheless apprehend, that it may be of some advantage to the public to state our notions with regard to the nature of the said mixture, as far as concerns the effect thereof, *viz.* In all the operations upon wool, the manufacturer endeavours either, first, to extend it by carding or spinning, or similar practices; or, secondly, to unite, condense, and connect the same by weaving, fulling, felting, and the like. In the first of these two distinct purposes it is necessary that the fibres of the wool should, by means of some lubricating matter, be made to slide easily over each other, instead of fixing, knotting, and entangling themselves together, and no material hath been heretofore known which was adequate to the effect, except oil in a pure state, or nearly so. Water itself is too harsh a fluid, and soon

evaporates;

evaporates; and the perfect combination of oil and alkali called soap (if dissolved in water in the large proportions requisite) is found to become stiff, and cleggs the staple or fibres of the wool. But our mixture being in fact a diluted solution of the best potash, or alkali of commerce, not in the caustic or chemically pure state (though in this degree of dilution the caustic alkali may be used in forming our said mixture), but naturally combined in part with carbonic acid; and this solution being mixed, by agitation, with a large proportion of oil, the result must consist of oil, minutely divided, slightly alkalized, and capable of being applied over the extensive surface of the fibres, together with a solution of mild or partly saturated alkali, which it is well known does not become perfectly dry, but is disposed to remain in the state of deliquescence. This last fluid is (as we apprehend from the facts) well adapted to assist in the lubrication along with the oil, and even to produce an effect, by their joint action, superior to that which either fluid singly could have done.

In witness whereof, &c.

REMARKS.

To the superiority which this mixture possesses over oil, as pointed out in the above specification, we have to add, that in the operation of scowering or cleaning the goods from the oil after they are wove, less time and labour is required. It is proper to observe, that in no instance is the effect of this composition, when applied to the wool, different from oil, except on very greasy or salvy wool, and on which we do not recommend its use (particularly in hot weather), unless such wool has been previously scowered.

Specification of the Patent granted to ANTONIUS BEMETZRIEDER, *of Chelsea, in the County of Middlesex, M. A.* ROBERT SCOTT, JOHN SCOTT, *and* ALEXANDER SCOTT, *all of Margaret-street, Cavendish-square, in the said County, Musical Instrument-makers; for making Piano Fortes, entirely new both in Principle, Construction, and Shape.* Dated November 10, 1801.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said Antonius Bemetzrieder, Robert Scott, John Scott, and Alexander Scott, do describe and ascertain the nature of our said invention, and in what manner the same is to be made and performed, as follows; that is to say:

First. The strings are fixed upon a frame, which has the shape of an irregular hexagon, in a way or method similar to, and imitating, as nearly as possible, the office of an horizontal harp. This string-frame is strong enough in itself to resist fully the drawing of all strings used either in grand or square piano fortes; and although the front and right sides of the frame are apparently connected with the exterior circumference, yet they require no additional strength from it, or from the bottom, to resist their respective drawing forces.

Secondly. The belly, with its two respective bridges, is fixed within the string-frame at the upper or widest part thereof, but an additional bridge can be added, dividing the compass of strings into three equal parts, and may be placed on the same belly, or on a separate small belly, at the lower or narrow extremity of the string-frame.

Thirdly.

Thirdly. The width of the string-frame is determined by the extention and compass of strings contained and placed on its respective bridges, *viz.* three unison strings to each note want eighteen inches for the largest width, and fourteen inches are sufficient for two unison strings to each note of an additional key'd instrument of sixty-eight keys.

Fourthly. The exterior circumference or outward case of the instrument is rectangular, the front-side circular, and the back, right and left sides straight; but, this circumference could be oval or triangular if so desired or required. The length and width are comparatively smaller than any one possible upon the old construction.

Fifthly. The front and back of the instrument have both doors in the middle near the string-frame. From the front doors the keys are drawn out for the player; and from the door in the back all the parts of the action can be regulated or mended when required.

Sixthly. The frame of the action is unconnected with the string-frame. Each frame is independent of the other.

Seventhly. Besides the ordinary motions up and down, the keys have an horizontal motion from the back to the front, and *vice versâ* from the front to the back.

Eighthly. The dampers are above the strings, but may also be under them. When above the strings they may be taken out one by one, being loosely suspended on the strings in an upper and under socket, which sockets are fixed to the front side of the string frame in an horizontal position. When under the strings, they draw out at the back-opening, in both cases their lifters are independent of the keys.

Ninthly.

Ninthly. The top of the instrument opens at the back by means of a swelling pedal; and at its front is a musick desk, which rises out of the top itself equi-distant from the extremities of the keys. This desk is first separated from the top, and afterwards affixed to the opening, made by such separation, by means of two small hinges, thus capable of being elevated to any degree of inclination the player may choose, being supported when elevated by a moveable back foot, which, together with the whole desk, shuts down within the limits of the said opening. The whole top is made to be taken off with the greatest ease, by unfastening the turn buckles or strong brass hooks which fasten it at its two ends or greatest extremities.

These differences from the old construction are not merely works of chance, they are grounded on principles either hitherto unknown or neglected.

First. Besides the known proportions, there is a maximum, that is, a more advantageous point where the hammer ought to strike the string. This maximum requires the action in the middle of the instrument.

Secondly. Strings riding upon a sonorous plank can give but a thin and stiff tone; but strings riding upon a sonorous body must give a finer, full, and singing tone. This is the reason that the new string-frame has all the solidity wanted to resist fully, and by itself, all the drawing forces, in order that a light and sounding back may form a sonorous body with the bridge-belly.

Thirdly. The piano forte music is harmony; and harmony proceeds in its propagation from the treble to the bass, and ought to go directly, and without reflection, from the action of the player to the ears of the auditors. This is the reason why these new instruments have the bass and swelling at their back.

Fourthly.

Fig. 1.

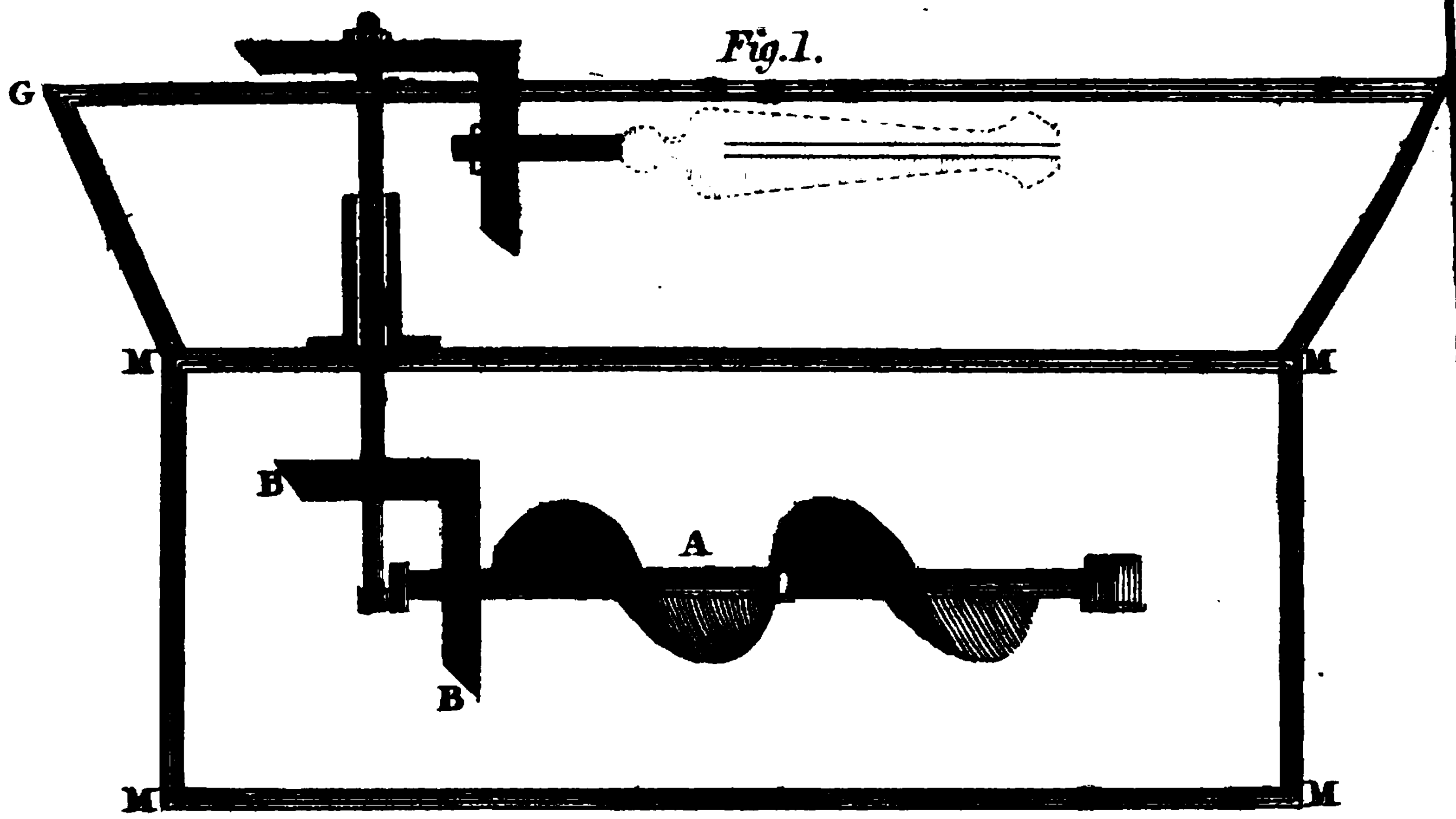


Fig. 2.

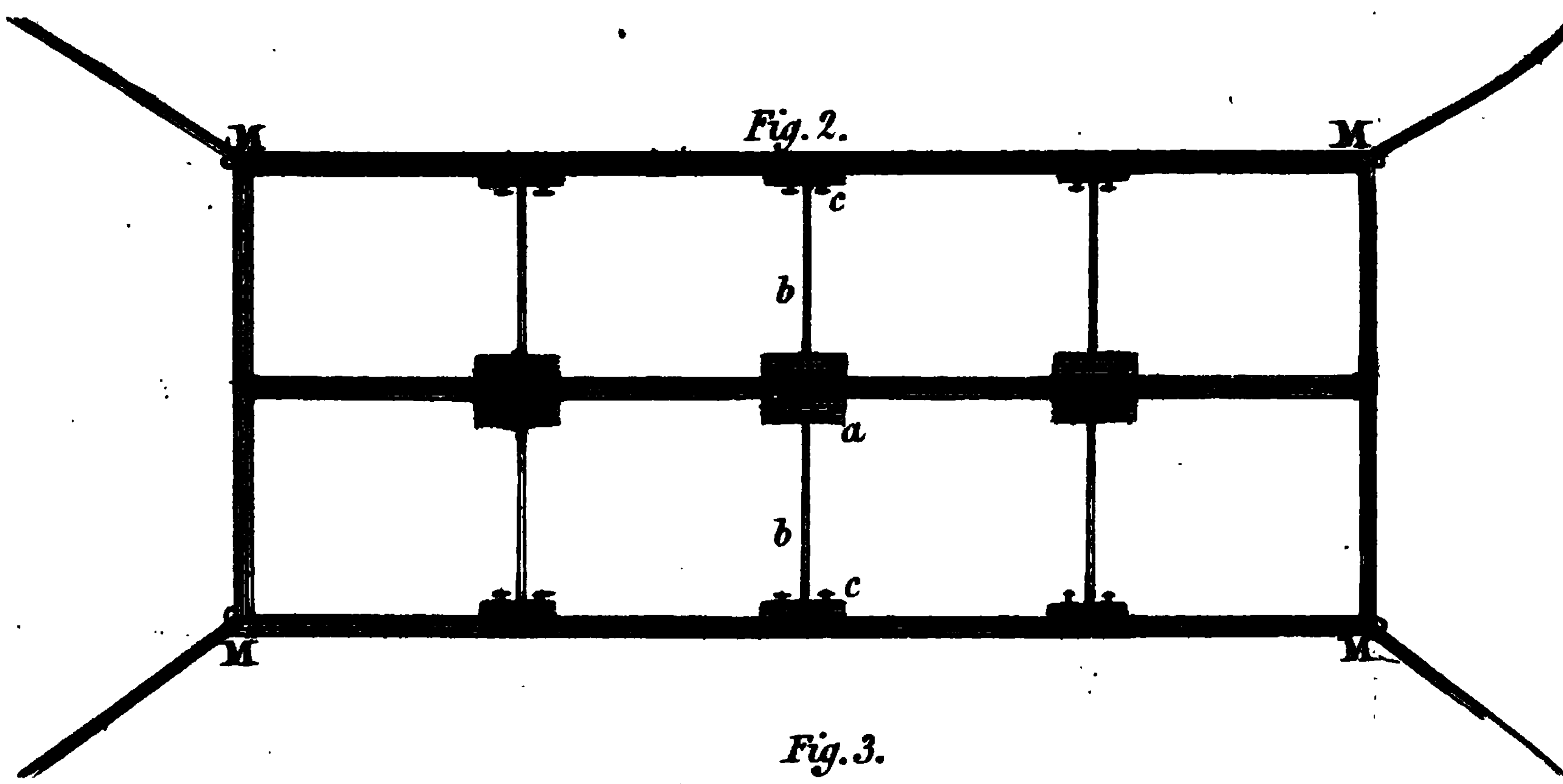


Fig. 3.

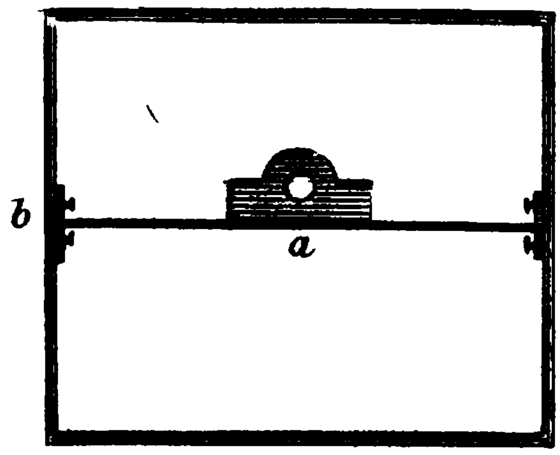
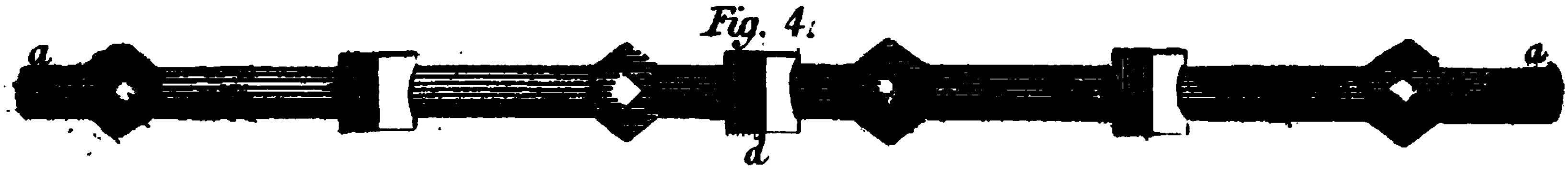


Fig. 4.



Fourthly. The piano forte takes its name from its particular movement, which must be simple, free, and elastic, in order that the player has under his fingers the piano's, fortes, more piano's, more fortes, pianissimo's, fortissimo's. This is the reason that all the parts of the instrument are independent one from another; and the whole so constructed as to obey the player who has taste and swelling at the end of his fingers.

In witness whereof, &c.

Specification of the Patent granted to JOHN NORTON, *of Rolls-buildings, Fetter-lane, Fleet-street, in the City of London, Mathematical Instrument-maker; for an Improvement in the Construction of a Water-Mill.*

Dated July 28, 1803.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said John Norton do hereby declare that my said improvements in the construction of a water-mill are described in manner following; that is to say: I apply a screw, either horizontally, vertically, or obliquely, to the impulse of the water, and in such a way that the screw may receive a motion from the water round its own axis; and being applied to, and connected with, any of the well-known machinery used in mill-work, shall produce and communicate to such said machinery such motion and effects as may produce the general purposes of a water-mill. I make the screw of wood, iron, copper, or any other material, the circumstance of size, place,

&c.

&c. may require, and either with single or double threads, and with one, two, or more threads, and deeper or less deep in the thread, as the said circumstance may require. The general appearance of a screw of this kind, and the method of applying it to other mill-work machinery, is shewn in Fig. 1, in the subjoined drawing.

A, Fig. 1, (see Plate XIII.) represents the screw with its axis. B, B, bevel-wheels, one of which is fixed on the axis of the screw, and the other on an axis which stands at right angles to it, and carries other mill-work machinery, &c. M M M M, is a vertical section of a rectangular or other conveniently-shaped vessel, open more or less to admit the access of the stream to the screw A. G G, a punt, barge, or other floating vessel, to which the machinery is fixed.

Fig. 2, represents the geometrical horizontal view of the vessel M M M M, shewing the method used to support the axis of the screw by iron or other bars *b*, *b*, bolted or otherwise fastened to the sides of the vessels at *c c*. In the centre of each bar is a plate *a*, on which is fixed a block or other stay, in which the axis of the screw is held in its required position.

Fig. 3, is an end geometrical view of the vessel M M M M, shewing in *b a b* the elevation of the bars *b*, in Fig. 2, and the block which holds the axis of the screw.

Fig. 4, represents in *a a* the axis of the screw being made of wood, iron, or any other material which may be relatively suitable to the intended size of the screw. It is made in one, two, or more lengths, and is joined by couplings, as at *d*, in the drawing, or otherwise.

In witness whereof, &c.

OBSER-

OBSERVATIONS BY THE PATENTEE.

The great object of this invention is to acquire more power from the impulse of the water than can be obtained by the common water-wheel, which does not receive the stream on above one-third of its circumference; and meeting with a considerable opposition from the surface in going down, and having a considerable weight of water to lift in rising, must subtract considerably from its power. But the screw moves freely with the stream, which it receives on its whole circumference at once, and meets with no opposition to lessen its power, which must therefore be at least three times that of the wheel.

Again: The wheel takes the stream near the surface; the screw takes the bottom of the stream, which is heavier and stronger, and, working under the vessel that carries the mill-work, is not liable to be damaged.

The above is applicable to any purpose that may require a moving power. Grinding of corn, boring cannon, &c.

Specification of the Patent granted to THOMAS FULCHER, *the Elder, of Ipswich, in the County of Suffolk, Surveyor and Builder; for a Water-proof Composition, in Imitation of Portland Stone, for stuccoing and washing new and old Stone and brick Buildings, and for cementing the Joints, and tucking and pointing all Stone and Brick Works that require Proof against Water.*

Dated May 27, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Thomas Fulcher do hereby declare that

my

my said invention of a water-proof composition, in imitation of Portland stone, consists in preparing and compounding the same in the following manner, *viz.* To three pecks of the best pit-sand, washed till perfectly cleansed from soil or dirt, dried and calcined, add twelve pounds of white-lead, well dried; one peck and a half of dried whiting and one pound of lithrage of gold. These are to be well mixed and beaten together with eight pints of linseed-oil and two pints of the spirits of turpentine, in a stone or wooden trough or mortar, till the whole becomes about the consistency of common putty. It is then fit for stuccoing. When required for washing only, then add to the above mixture twenty pints of linseed-oil and ten of the spirits of turpentine and one pound of litharge of gold, the whole well mixed. Although these proportions are given as those which will be found best for general purposes, yet they may be varied according to the discretion and judgment of the workman. The stuccoing is to be performed in the same manner as plastering, and requires two coats, observing however not to lay on the second coat till the first is quite dry. Old walls must be prepared by cutting out the bad parts of the stone or brick, and replaced with new. The washing is done in the manner of painting, and requires two coats, the second colouring not to be laid on till the first is perfectly dry. This stucco and wash have the properties of keeping out all damps and wet effectually.

In witness whereof, &c.

A Description

Fig. 1.

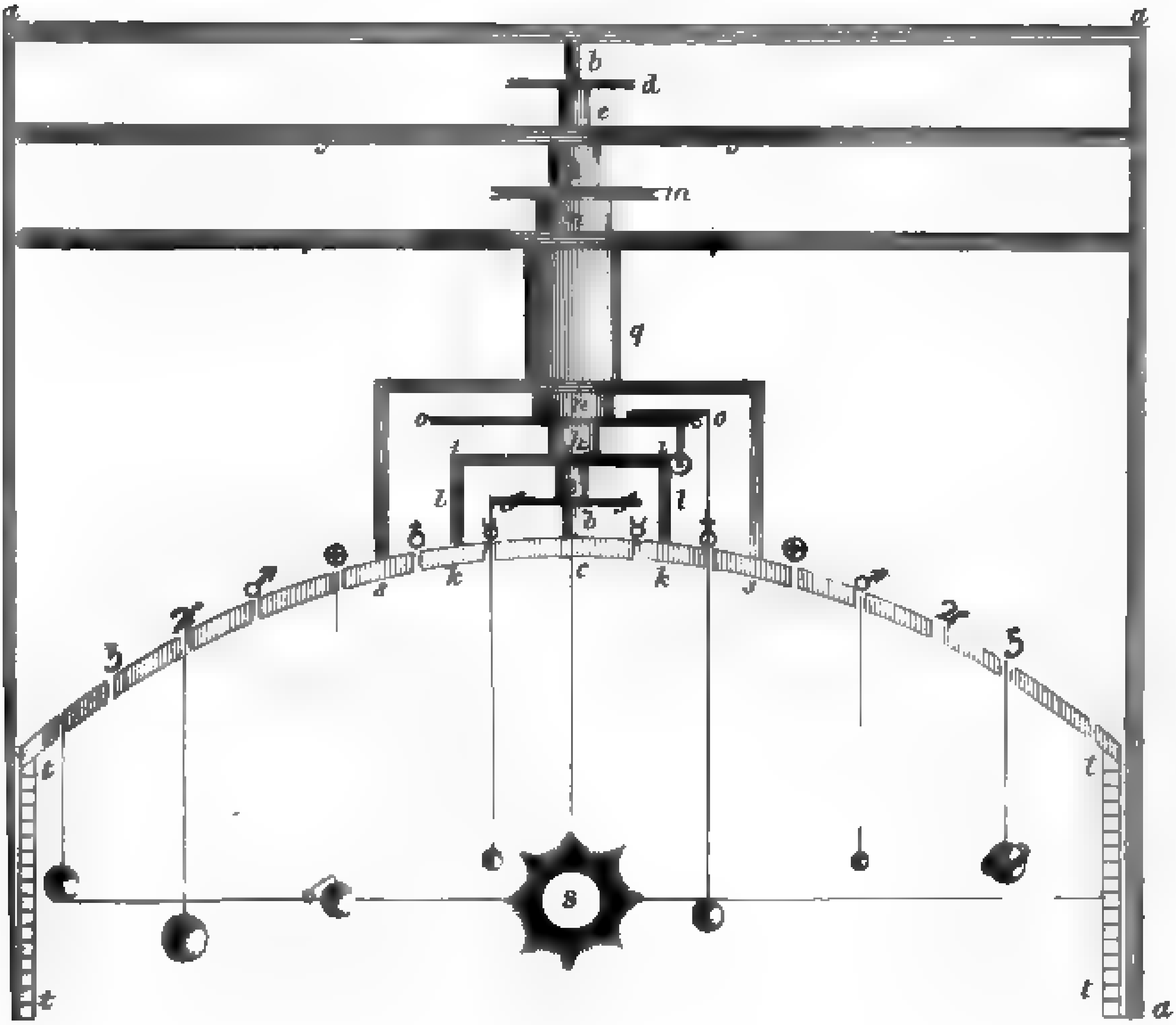
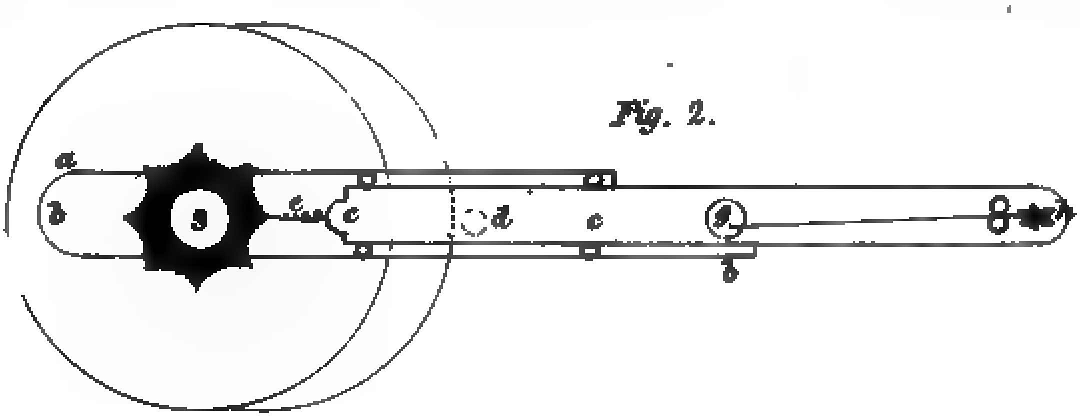


Fig. 2.



A Description of the Pendant Planetarium.

Invented by Burgiss Allison.

With a Plate.

From the Transactions of the American Philosophical Society.

Fig. 1, *a a a a*, is a frame, supporting the whole machine. *b b*, is a fixed rod or arbor supporting the segment *c*, and the sun S by a fine wire. *d*, is a wheel, fixed to the upper part of the cannon *e*, carrying round by its lower end the arm *f f*, and the planet Mercury suspended by a fine dark wire. *g g*, is an arm, fixed by screws into the frame *a a* at each end, and also to the upper end of the fixed cannon *h h*, which supports by its lower end the frame *i i*, which, as explained in Fig. 2, is an elliptic plane, supporting, by four or more studs *l l*, the concave piece *k k*, forming an elliptic ring. *m*, is a wheel on the moveable cannon *n n*, which carries the arm *o o*, supporting on one end the planet Venus by a fine wire, as above. *p p*, as before, is a fixed frame attached to the immoveable cannon *q* and the elliptic plane *r r*, supporting by studs the concave rings *s*, *s*, *ut supra;* and thus the wires, by which the planets are suspended, and the concave rings are alternately supported by the moveable and fixed cannons, &c. until the whole forms a concave like the heavens; having the small grooves or apertures through which the planets supporters move round, forming elliptic lines in the concave segment of a sphere, marking out the planets paths, according to their eccentricity, and shewing at one view the places of aphelion, perihelion, &c. of all the planets. The concave

silver stars, in the position that some of the fixed stars would appear from the centre of the sun, will have a fine effect, especially as the supporting wires of the planets will be dark, and so small as to render them almost invisible, the frame being suspended from the ceiling. Their latitude may readily be ascertained by a line drawn from the centre of the sun through that of the planets place to the hoop *t t*, encompassing the whole, marked with eight degrees on each side of the ecliptic. The elliptic orbits and inclined planes are obtained by the method shewn in Fig. 2, *viz.*

a a, is an elliptic plane, fastened to the lower end of each fixed cannon, having its eccentricity calculated to that of the planet which is to be affected by it. *b b*, is the arm attached to the moveable cannon. *c c*, is a slider moving on the arm *b b* by four little friction rollers. *d*, is a friction wheel on the under side of *c*, turning on a pin, which is fastened firm on *c*, and moves with it through a groove in *b b*, which wheel, running against the edge of the ellipsis *a a*, forces *c c* out, which is again drawn in by the spring *e*, thus causing the planet to revolve in an elliptic orbit, as it is carried round by the arm *b b*, the moveable cannon, and wheel-work.

For the inclined plane, *g* is a wheel turning on a pin fastened into *c c*, and carried round on it by a projecting arm of *b*.*. On one side of this wheel is a small pin, whose situation and distance from the centre is to be determined by the place of the planet's nodes, and the inclination of its plane to that of the ecliptic; to this pin is fastened a small waxed silk cord, which, passing

* The circumference of the wheel must be commensurate with the distance *c c* moves out.

over

over the pulley *h*, supports the planet by a fine hair wire, as before described, and draws it up and lowers it down in its orbit according to its angle of inclination to the plane of the ecliptic. The planets should be made of polished metal, to give them weight and brilliancy, or of small glass globes filled with mercury. The sun may be a globular glass fountain-lamp, with a cork fitted to the tube, containing a tin pipe for the wick, so that the blaze being in the centre of the globe, and surrounded with oil, will be magnified on every side, and exhibit a splendid sun. It will be readily understood that motion is to be given to the wheels, turning the cannons, &c. by an arbor having as many wheels as the planets have, all firmly fixed to the arbor, and calculated to move them in their proper periods. The whole may be made of wood, if required, and the wheels turned by elastic wire bands. To the machinery may be attached a simple movement, whose weight may descend down the wainscot of the room in any convenient place. Thus the planets will be seen moving round the sun in the concave above, in elliptic orbits and inclined planes, apparently revolving in the heavens without any support.

It is easy to conceive how the same principle, as far as it respects the eccentricity and angles of inclination, may be applied to either vertical or horizontal orreries; by having the wires which support the planets sufficiently stout to bear their weight either in a perpendicular or horizontal position, and sliding in and out of small tubes as they pass round in the elliptic grooves on the face of the orrery. They may be drawn in by the wheel-pin and cord, as described in Fig. 2, and forced out by small springs. In this case their latitude may be marked

on

on the supporting wire, and the top of the tube in which they slide will serve as an index. Or the degrees may be marked on the edge of a groove cut in the tube, through which an index, fastened to the moving wire or stem which supports the planets, may pass; and thus give the latitude.

Appendix to Mr. WILLIAM HENRY'S *Paper on the Quantity of Gases absorbed by Water at different Temperatures, and under different Pressures**.

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

SINCE my paper was printed, I have found that the numbers assigned in it, as indicating the quantities taken up by water, of some of the more absorbable, and of all the less absorbable gases, are rather below the truth. The accuracy of these numbers I was led to doubt, by a suspicion that due attention had not always been paid, in my former experiments, to the quality of the unabsorbed residuum. For the theory which Mr. Dalton has suggested to me on this subject, and which appears to be confirmed by my experiments, is, that the absorption of gases by water is purely a mechanical effect, and that its amount is exactly proportional to the density of the gas, considered abstractedly from any other gas with which it may accidentally be mixed. Conformably to this theory, if the residuary gas contains $\frac{1}{2}$, $\frac{1}{10}$, or any other proportion of foreign gas, the quantity absorbed by water will

* See the last Number of this work, page 255.

be

be $\frac{1}{2}$, $\frac{1}{10}$, &c. short of the maximum. The proof of these propositions would lead me into a minuteness of detail, not suited to the present occasion; I therefore hasten to communicate the results of my latest experiments.

The report which I have already given, of the quantity of carbonic acid gas, absorbed under the ordinary pressure of the atmosphere, I find no reason to correct; but, of sulphuretted hydrogen gas, I have effected a larger absorption than the one before stated; and have repeatedly observed its amount to be 106 or 108 by 100 measures of water, at 60° of Fahrenheit, which temperature is to be understood in all the following experiments.

Of several experiments on the absorption of nitrous oxide, I take the following, as a fair example of the whole. I agitated, at three several times, 1175 measures of nitrous oxide, with 1320 measures of water; 1025 parts of gas disappeared, and the unabsorbed remainder (150) contained 15 of foreign admixtures. It follows, that 100 parts of water had taken up 77.6 of nitrous oxide; and, after adding to these the diminution of absorption occasioned by the impurity of the residuum, it may be inferred, that 100 parts of water would absorb 86 of absolutely pure nitrous oxide.

With respect to the remaining gases, I have been prevented, by urgent professional engagements, from examining the quantity of each, absorbable under similar circumstances, except in the instances of oxygenous, azotic, and hydrogenous gases. The results of these experiments are comprised in the following table. The first column shows the quantity of gas which 100 parts of water, at 60°, have actually absorbed; the second, the quantity which ought to be taken up, provided the residue were in a state of absolute purity. In the example of

of nitrous gas alone, the estimated is less than the actual absorption; because a small portion of this gas loses its aërial form, by union with the oxygenous gas, from which water cannot be entirely freed.

Table shewing the Quantity of each Gas absorbed by 100 Measures of Water, at 60°.

	Actual Absorption.	Inferred Absorption.
Nitrous gas	5	5
Oxygenous gas	3.55	3.7
Phosphuretted hydrogen gas	2.14	
Gaseous oxide of carbon	2.01	
Carburetted hydrogen gas	1.40	
Azotic gas	1.47	1.53
Hydrogenous gas	1.53	1.61

Hints as to the Advantages of old Pastures, and on the Conversion of Grass Land into Tillage.

From Essays on Miscellaneous Subjects. By Sir John Sinclair, Bart.

Having corresponded with some intelligent proprietors, and practical farmers, on the important question recommended by the Board of Agriculture to the attention of the public, namely, "*The Propriety of converting* "*Pasture Land into Tillage,*" I have thought it a duty incumbent upon me, as a Member of the Board, and a well-wisher to the improvement of the country, to communicate the result of that correspondence, as several of the observations transmitted to me on that subject seemed to be of considerable importance.

I. *Advantages*

I. *Advantages of old Pastures.*

Before, however, the propriety of ploughing up old pastures is discussed, it may be proper, in the first place, to point out some of the most important advantages to be derived from them.

1. The first advantage contended for is, that old pastures answer better for making butter and cheese than artificial grasses, and the idea is probably well founded. All seeds, particularly clovers, give the milk a strong taste, and although the quantity may be as great, or even greater, yet the quality is always worse; it will cast up less cream in proportion, the butter is less firm and waxy, and it will not keep so well. The cheese also is considerably inferior.

2. It is next asserted, that old pastures are better calculated for feeding cattle and sheep; but this can only be admitted with certain qualifications. In the opinion of that respectable farmer, Mr. Culley, (who has had fifty years experience in the grazing line,) "Artificial "grasses, suited to the different soils, will be found to "answer better than old grass, for feeding cattle, ewes, "and lambs, during the beginning, and for the greater "part of the summer; and even during the autumn, ar"tificial grasses will feed ewes and lambs better than old "grass; whereas, on the other hand, fogs (or after-maths, "as they are called in the southern parts of England) from "old grass, will certainly feed cattle better in the au"tumn, the richness, luxuriance, and strength of such "herbage, being better calculated for their constitu"tions." It is believed, indeed, that it is hardly possible to fatten a large ox, to any degree of perfection, on herbage alone, without such pastures.

 3. It

3. It is farther contended, that the hay made from old grass, though not so bulky, yet is of a better quality, and will keep longer in a good condition than hay made from artificial grasses, particularly from a mixture of clover and rye-grass.

II. *Description of the Lands that ought to be kept perpetually in Grass.*

As old pastures are attended with such peculiar advantages, it is desirable to know, what description of land ought to be kept perpetually in grass. It is certain that there are many old grazing pastures, which can afford to pay a considerable permanent rent in grass, even at a distance from any populous town, the value of which might be reduced if subjected to the plough. It is the opinion of Mr. Culley, that soft heavy loams, with a clayey or marly bottom or substratum, are universally injured by ploughing. Water-meadows also should never be ploughed, as they furnish so large and valuable a produce in spring, in summer, and in autumn, without any other help than water, whilst the manure made from that produce goes to enrich the rest of the farm.

With these exceptions, and that of land apt to be overflowed, there is every reason to believe, that old pastures may occasionally be converted, with public advantage and private benefit, into arable land.

III. *Obstacles to the Conversion of old Pastures into Tillage.*

Before, however, the conversion of old pastures into tillage is recommended, it is right to consider, what are the obstacles which may stand in the way of such conversion; for, unless they are removed, any recommendation to that effect would be useless. These obstacles

stacles, are, 1, Tithes; and, 2, The restrictions of the landlord.

In regard to tithes, whilst they continue undefined, they operate, in a peculiar manner, against the conversion of old grass lands into tillage, by depriving both the landlord and tenant of so large a proportion of the profit to be derived from it; and as there is every reason to believe, that a very considerable extent of land in England is kept perpetually in grass, in order to avoid the payment of tithes in kind, is it not a most unfortunate circumstance, that some means are not thought of for commuting, on equitable terms, a right that operates injuriously to the agricultural interests of the country?

As to the restrictions of the landlord, they are often necessary for the protection of his property. But, in the course of the inquiry, it will probably be in the power of the Board to point out the conditions under which old pastures may be ploughed up, not only without detriment, but with advantage to the landlord, and to the public.

IV. *Preparation of the Soil.*

The preparation for the tillage crops may be considered under three heads: 1, Draining; 2, Paring and burning; and, 3, Manuring.

In regard to *draining*, it should be done effectually before the land is attempted to be ploughed; for very possibly it may have been kept in pasture on account of its wetness.

As to *paring and burning*, it is certainly a useful practice where old grass lands are broken up, for it destroys numberless eggs and larvæ of insects, which are extremely injurious to the succeeding crops, and it almost

 insures

insures the tenant from any damage he is otherwise likely to sustain from wire-worms, grubs, &c. Indeed where the land is rough, with furze bushes, brambles, ant-hills, strong heath, &c. it is hardly to be dispensed with. If the land is so smooth and friable that paring and burning is not necessary, the best plan to adopt is, *to double plough it*, by means of two ploughs following each other, the first plough taking off a thin surface of about three inches, and the second going deeper in the same place; both furrows not to exceed six inches. Mr. Ducket's skim coulter does the work at one operation. This plan is certainly the best to pursue where paring and burning, from prejudice or any other circumstance, will not be permitted.

As to *manuring*, if the land is not to be pared and burnt, lime might be spread on the surface, some time before ploughing, in order to destroy grubs and insects; but old pasture lands are in general rich enough to be abundantly productive, without dung, until they are about to be laid down into permanent pasture.

V. *Course of Crops.*

The rotation of crops must depend upon the nature of the soil, and the manner in which it is prepared for cultivation.

If the land is pared and burnt early in the season, turnips is the best article that can be sown; and it is found by experience, that turnips thus raised will go farther in feeding cattle or sheep than any other. If it is late in the season before the land is burnt, cole or cabbage may be adopted: if the land is broken up without being pared or burned, early oats will be found the most profitable crop, being so extremely productive on all fresh clean ground. Mr. Culley states, that there are various sorts

of

of early oats, suited for the different soils: for instance, on rich leys of strong loam, Polish oats ought to be preferred, of which that sort called Church's oats, is by far the best variety. On lighter soils, the Dutch, or Friezeland oat has been found to answer best: but, on the whole, on loamy soils, no species has been found comparable to the potatoe oat, so called from its having been accidentally found in a field of potatoes, in one of the northern counties. In regard to the succeeding course, on dry soils, turnips, potatoes, and clover, ought to be the prevailing green crops; on mixed soils, beans may be added; and when the mixture inclines to heaviness, cabbages. The following rotation is particularly recommended, on a lightish soil, by Sir Alexander Ramsay; namely, 1, Oats; 2, Turnips, with dung and lime; 3, Barley, with seeds; 4, Clover; 5, Wheat; 6, Turnips; 7, Barley and grass seeds; and then to remain in pasture. This intelligent and respectable farmer is decidedly of opinion, that a complete rotation of seven years is to be preferred to any shorter term. The farmer is thus enabled to profit by his labour, and thoroughly to pulverize and reduce the soil. It may then be laid down in a husbandman-like manner, enriched, and not exhausted, and likely to produce both hay and pasture in abundance and perfection.

VI. *Management during the Rotation.*

When land of a light quality is laid down with turnips, sheep should be folded on them. If the land is strong, or wet, the green crops grown thereon ought to be drawn, and fed in some adjoining grass field, or in sheds. If the land is in very high health and condition, some farmers would be inclined to cart off half the turnips, and

to eat the rest on the ground, though this is not a plan to be universally recommended.

In regard to manuring, it may be proper to observe, that the dung and lime ought to be applied to the turnips, or other green crop, but never to the different sorts of grain.

VII. *Mode of laying down to Grass.*

Grass seeds in general should be sown with the barley, or the crop succeeding turnips, or any other green crop that may be preferred: *the quantity* of grass seeds must be governed by the state and quality of the soil. Old tillage land requires, in addition to the clover, three pecks, or one bushel of rye-grass seed *per* acre; whereas new-ploughed lands may do with half that quantity, or even less. Heavy lands, if they are to be broken up again in one or two years, require from 10 lbs. to even 20 lbs. of red clover, besides a bushel of the best or Pacey rye-grass; for the seeds are very apt to miss on such soils, except in very favourable growing seasons; but if such lands are to remain in grass, from 4 lbs. to 6 lbs. of marle-grass or perennial red clover, and 4 lbs. to 5 lbs. of white, with as much yellow or hop clover, and a bushel of the best rye-grass, will be necessary. If any doubt is entertained regarding the marle-grass, from 4 lbs. or 5 lbs. of common red clover may be used in its stead. All dry soils may have from 2lbs. to 4lbs. of hop or yellow clover seed *per* acre, in addition to the white clover seed, and the perennial red clover, or marle-grass already mentioned. The following plan is recommended by Mr. Bridge (a respectable farmer in Dorsetshire) for laying down land for permament pasture; namely, to sow from 6 lbs. to 7 lbs. of white clover; ditto, either of marle-grass or of common red clover; ditto, of hop clover; and

one bushel of the best Devonshire rye-grass, which resembles much the Pacey rye-grass. By this means, there is a perpetual feed for five or six years. The hop, clover, and rye grass flourish early in the spring; the marle-grass is in perfection in July, when the other goes off; and the white clover is in perfection in August, and continues during the remainder of the season. In some meadows of very rich soil, perhaps lucerne ought to be preferred, and it would be of infinite importance to have it ascertained, to what extent that culture could be carried.

As to providing the seed, much must depend upon the character of the tenant, who may often be intrusted with that charge; but if he is too fond of the plough, it is the safest plan for the landlord to provide the seeds, as it must be for his interest to procure the best that can be purchased, to prevent any necessity, from the unproductive sate of the grass, to have again recourse to tillage.

VIII. *Increase of Rent.*

It is evident that any tenant would be willing and able to give an increase of rent for the liberty of ploughing up old pastures. What the addition ought to be, must be governed by the situation, the quality of the land, the price of grain, and other circumstances. In Scotland, double rent and upwards is not unusual on a lease of four years. The Earl of Rosebery lately let about 300 Scotch acres of old pasture at that rate, some part of which produce 8 *l. per annum* *. It had been pastured, however, for more than sixteen years, and was situated within eight miles of Edinburgh. The high rent, pay-

* Equal to 6 *l.* 8 *s. per* English acre. In many instances old pasture land would fetch in Scotland from 8 *l.* to even 10 *l. per* English acre.

able

able for such lands in Scotland, may be attributed to the following circumstances:

1. That land fit for tillage is less abundant in the northern part of the island than in England. 2. That old pastures are peculiarly well calculated for producing oats, the general food of the people *. 3. That such lands are in general so rich as to require but little manure, consequently the manure arising from the crops they produce may, in a great measure, be devoted to the improvement of the rest of the farm. 4. That the tenants in Scotland are not subjected to the payment of tithes, nor of poor-rates, or other taxes. And, lastly, that there is either a greater spirit of speculation among the Scotch farmers, or that they are contented with less profit than the English.

IX. *Conditions under which the Liberty of Ploughing may be granted.*

But the increase of rent is not the only particular that a landlord has to take under his consideration when he grants the liberty of ploughing up old pastures. Unless care is taken, when they are broken up, that it is done under a proper system of management, the execution of which is enforced by the strictest regulations, the real value of the property may be materially injured. The conditions, therefore, that ought to be stipulated by the landlord, is certainly not the least important branch of this inquiry.

In considering the general nature of the conditions that ought to be required, I have derived much benefit from perusing the articles which were obligingly com-

* It appears from the corn tables, that wheat is almost always cheaper in Scotland than in England, and oats the reverse.

municated

municated to me, by the Earl of Rosebery, and, according to which, that noble lord, in January, 1801, let a considerable tract of old pasture land, part of the estate of Dalmeny, in the neighbourhood of Edinburgh.

Art. 1. By this article the fields were to be set up to auction, and the highest bidder was to find security to fulfil the terms he had agreed to.

Art. 2. The grounds were let for four years. First crop, *oats*; second crop, *turnips or other green crop*; if a naked fallow, four ploughings; third crop, *barley and grass seeds*, with two or three ploughings; and, fourth crop, *hay*; prohibiting wheat, hemp, flax, &c. under the penalty of 10*l. per* acre of additional rent.

Art. 3. The tenant to plough the land properly, to hoe and weed it, &c. to sow with the third crop at least one bushel and a quarter, or one Scotch firlot, of rye-grass, 12 lbs. or 14 lbs. good red clover seed, and 4 lbs. white clover, and sufficiently to harrow, stone, and roll the same, entirely at his own expense.

Art. 4. The tenant to have liberty to cut and carry away the foggage, or second crop of grass, in the fourth, or last year, but not to pasture the same *, and to remove every article belonging to him on or before the 1st of November, 1804.

Art. 5. The tenant to preserve the gates and fences, to keep the ditches, &c. clear and open, and to leave them in good condition at his removal, and, if neglected, the same to be done by the landlord, at the tenant's expense.

Art. 6. The tenant who shall be preferred, to sign a proper deed or instrument, with a sufficient surety, specifying the terms agreed upon.

* This restriction was intended for the preservation of young fences; but, where the fields are completely fencible, Lord Rosebery prefers obliging the tenant to pasture the second crop of clover.

Art. 7. Accommodation given to the tenant to stack and thresh the crop, under certain obligations, that he shall keep the barn and corn-yard in repair.

Art. 8. An arbiter appointed to determine all differences: the expense attending any dispute to be paid by the person against whom judgement shall be given.

Art. 9. Tenants to remove, without the necessity of previous notice, under certain penalties.

Art. 10. Power reserved to the landlord, or to persons he may appoint, to inspect the fields from time to time, also to work coal and lime-stone, and other stones or gravel, to sink or dig pits, to make roads, and to do every thing necessary for carrying on such works, (allowing to the tenant the yearly value of the ground thus taken up, or rendered useless,) also reserving the power of carrying off wood and underwood, paying the damages arising therefrom.

It is evident, that, under such prudent conditions as these, if properly enforced, the most cautious landlord may suffer old pasture lands to be converted into tillage, without any material risk of his property being thereby injured.

X. *On the Propriety of laying down some of the Tillage Land into Grass.*

Wherever circumstances will admit of it, the landlord will find it for his interest to lay down the same quantity of old arable land into pasture that is broken up from pasture and rendered arable, by which change the farm will, on the whole, be much improved, and consequently it is for the advantage of the landlord to consent to the alteration. It is, at the same time, in the opinion of one of our most intelligent farmers, (Sir Alexander Ramsay,) one of the most difficult operations in husbandry, to lay down

down old tillage land that has been for years under a ploughing system, (as under fallow, wheat, beans, &c.) into permanent grass. One rotation will not be sufficient to produce good pasture; it may be found necessary to have two complete rounds of management, different from what the land has been accustomed to; as, 1, turnips, cabbages, or summer fallow. 2. Barley, with 12 lbs. of clover and ½ bushel of rye-grass to each acre. 3 and 4. Clover, to stand two years. 5. The clover to be broke up for drilled beans or peas, according as the land is heavy or light. 6. Turnips, with manure. And, 7, barley, with such grass seeds as are fit for permanet pasture. When the field has gone through these rotations, and in the course of them has been twice manured, it can hardly fail to produce good pasture, more especially if care be taken the first year to feed it off with sheep.

XI. *On the greater Productiveness of Arable compared to Pasture Lands.*

Having thus shortly stated the manner in which old pasture lands may be converted into tillage, it may be proper briefly to explain how much the public is interested in such a conversion, in consequence of the much greater quantity of food for man, that is produced by land in tillage. According to Archdeacon Heslop's comparative statement lately published, the weight of food from an acre of arable, on the average of three years, a fallow year being included, is nine and a half times greater than from an acre of feeding stock; and, according to the calculations of a very intelligent correspondent of the Board, the Reverend Dr. Walker, of Collington, a Scotch acre of land in pasture, fed with sheep, produces only 120 lbs. weight of meat; whereas the same land will yield 1,280 lbs. weight of oatmeal, or above ten

 time

times as much in weight *. This is so important a circumstance, in a public point of view, that it merits particular attention, as it tends to prove, that where one million of people may be maintained by pasturage, several millions may be maintained by tillage, and without any additional extent of ground for working horses, cattle, &c. if the land be cultivated by the spade.

XII. *Conclusion.*

On the whole, though it may not be advisable to recommend the ploughing up of very rich old pastures, or water meadows, or land apt to be overflowed, yet, with these exceptions, there is every reason to believe, that other sorts of grass lands may be rendered much more productive, by being occasionally converted into tillage; and for that purpose it is desirable, that the conversion of such lands should be promoted as much as possible; by removing the obstacles to such conversion;—by enforcing the necessity of commuting tithes, without which no considerable tract of old pasture can be broken up;—by pointing out to landlords the conditions under which they may agree to such a plan, not only without detriment to the real value of their property, but also yielding a most important addition to their income;—and, above all, by explaining to parliament, and to the public, that the measure above recommended is one which may effectually tend to prevent future scarcities; and to render this country independent of foreign nations, in the important article of provisions.

* If cultivated in whole, or in part, with potatoes, the difference would be still greater. At the same time it is to be observed, that grain will not go so far as meat in the maintenance of man. The proportional difference between the two has not yet been ascertained.

On

On the Nourishment of Vegetables.

By A. HUNTER, *M. D.*

FROM HUNTER'S GEORGICAL ESSAYS.

I LAY it down as a fundamental maxim, that all plants receive their principal nourishment from oily and mucilaginous particles incorporated with water, by means of an alkaline salt or absorbent earth. Till oil is made miscible, it is unable to enter the radical vessels of vegetables; and, on that account, Providence has bountifully supplied all natural soils with chalky or other absorbent particles. I say natural soils, for those which have been assisted by art are full of materials for that purpose; such as lime, marl, soap-ashes, and the volatile alkaline salt of putrid dunghills.

It may be asked, whence do natural soils receive their oily particles? I answer, the air supplies them. During the summer months, the atmosphere is full of putrid exhalations arising from the steam of dunghills, the perspiration of animals, and smoke. Every shower brings down these putrescent particles for the nourishment of plants. Of these, some fall into the sea, where they probably serve for the nourishment of fuci, and other submarine plants. They are, however, but seemingly lost, as the fish taken from the sea, and the weeds thrown upon the beach, restore them again under a different form. Thus Providence, with the most consummate wisdom, keeps up the necessary rotation of things, dissolution and combination following each other in endless succession.

When the putrescent particles that are suspended in the atmosphere happen to fall upon a very sandy soil, the solar heat exhales the most of them. Hence an additional

reason

reason for covering our light soils with herbage during the summer months.

On the contrary, when these particles fall upon stiff land, or such as have been marled or limed, an intimate union is produced, too strong for the solar heat to exhale.

It is observed, that lime mechanically binds a hot sandy soil. We now see that it also fertilizes it; but the farmer must not presume too much upon that quality.

The ingenious Mr. Tull, and others, contend that earth is the food of plants. If so, all soils equally tilled would prove equally prolific. The increased fertility of a well pulverized soil induced him to imagine that the plough could so minutely divide the particles of earth, as to fit them for entering into the roots of plants.

An open soil, if not too light in its own nature, will always produce plentiful crops. It readily receives the air, rains, and dews into its bosom, and at the same time gives the roots of plants a free passage in quest of food. This is the true reason why land well tilled is so remarkably fruitful.

Water is thought, by some, to be the food of vegetables, when in reality it is only the vehicle of nourishment. —Water is an heterogeneous fluid, and is no where to be found pure. It always contains a solution of animal or vegetable substances. These constitute the nourishment of plants, and the element in which they are minutely suspended, acts only as a vehicle in guiding them through the fine vessels of the vegetable body.

The hyacinth, and other bulbous roots, are known to perfect their flowers in pure water. Hence superficial observers have drawn an argument in favour of water being the food of vegetables. But the truth is, the roots, stem, and flowers of such plants are nourished by the

mucilaginous

mucilaginous juices of the bulb, diluted by the surrounding water. This mucilage is just sufficient to perfect the flower—and no more. Such a bulb neither forms seeds, nor sends forth off-sets. At the end of the season it appears weak, shrivelled, and exhausted, and is rendered unfit to produce flowers the succeeding year. A root of the same kind, that has been fed by the oily and mucilaginous juices of the earth, essentially differs in every particular. It has a plump appearance, is full of mucilage—with off-sets upon its sides.

All rich soils, in a state of nature, are thought to contain oil and mucilage; and in those lands which have been under the plough for some years, they are found in proportion to the quantity of putrid dung that has been laid upon them, making an allowance for the crops they have sustained.

To set this matter in a clearer light, let us attend to the effects of manures of an oily nature, and we shall soon be satisfied that oil, however modified and distinguished, is one of the chief things concerned in vegetation.

Rape-dust, when laid upon land, is a speedy and certain manure, though an expensive one, and will generally answer best on a limestone land, or where the soil has been moderately limed.

This species of manure is much esteemed by the farmer. It contains the food of plants ready prepared; but as it is not capable of loosening the soil by any fermentation, the lands upon which it is laid ought to be in excellent tilth. At present, that useful article of husbandry is much diminished in goodness, owing to the improved methods of extracting the oil from the rape. Heat and pressure are employed in a double degree, and every other method is used to the prejudice of the farmer. Some persons, however, are of opinion, that the severe

extraction

extraction of the oil does not materially injure the rape-dust.

Farmers that live in the neighbourhood of large towns use abundance of soot. It is an oily manure, but different from the former, containing alkaline salt in its own nature, calculated as well for opening the soil, as for rendering the oily parts miscible with water.

It is observed that the dung of pigeons is a rich and hasty manure. These animals feed chiefly upon grains and oily seeds; it must therefore be expected that their dung should contain a large proportion of oil.

The dung of stable-kept horses is also a strong manure, and should not be used until it has undergone the *putrid ferment*, in order to mix and assimilate its oily, watry, and saline parts. Beans, oats, and hay, contain much oil. The dung of horses, that are kept upon green herbage, is of a weaker kind, containing much less oil. Swine's dung is of a saponaceous and oily nature, and perhaps is the richest of the animal manures. When made into a compost, and applied with judgement; it is excellent both for arable and grass lands. The dung of stall-fed oxen, especially if oil-cake make part of their food, is of a rich quality, and greatly preferable to that of cows and oxen supported by grass only. A farmer, when he purchases dung, should attend to all the circumstances under which it is produced. One load of dung from a hunting stable, where much corn is used, is worth two loads produced by hay and green provender.

The dung of ruminant animals, as cows and sheep, is preferable to that of horses at grass, owing to the quantity of animal juices mixed with their food in chewing. And here I beg leave to remark in general, that the fatter the animal, *cæteris paribus*, the richer the dung.

Human

Human ordure is full of oil and a volatile alkaline salt. By itself it is too strong a manure for any land; it should therefore be made into a compost before it is used. The dung of carnivorous animals is plentifully stored with oil. Animals that feed upon seeds and grains come next, and after them follow those which subsist upon grass only.

To suit these different manures to their proper soils, requires the greatest judgement of the farmer; as what may be proper for one soil may be highly detrimental to another.

In order to strengthen my argument in favour of oil (phlogiston) being the principal food of plants, I must beg leave to observe, that all vegetables, whose seeds are of an oily nature, are found to be remarkable impoverishers of the soil, as hemp, rape, and flax; for which reason, the best manures for lands, worn out by these crops, are such as have a good deal of oil in their composition; but then they must be laid on with lime, chalk, marl, or soap ashes, so as to render the oily particles miscible with water.

The book of Nature may be displayed, to show that oily particles constitute the nourishment of plants in their embryo state; and, by a fair inference, we may suppose that something of the same nature is continued to them as they advance in growth. The oily seeds, as rape, hemp, line, and turnip, consist of two lobes, which, when spread upon the surface, form the seminal leaves. In them the whole oil of the seed is contained. The moisture of the atmosphere penetrates the cuticle of the leaves, and, mixing with the oil, constitutes an emulsion for the nourishment of the plant. The sweetness of this balmy fluid invites the fly, against which no sufficient remedy has, as yet, been discovered. The oleaginous li-

 quor

quor being consumed, the seminal leaves decay, having performed the office of a mother to her tender infant. To persons unacquainted with the analogy between plants and animals, this reflection will appear strange. Nothing, however, is more demonstrable.

Most of the leguminous and farinaceous plants keep their placenta, or seminal leaves, within the earth; in which situation they supply the tender germ with oily nutriment, until its roots are grown sufficiently strong to penetrate the soil. The curious reader will find this subject treated of at large in the third essay.

It is usual to talk of the salts of the earth, but chemistry has not been able to discover any salts in land which has not been manured; though it is said that oil may be readily obtained from every soil, the very sandy ones excepted.

Marl, though a rich manure, has no salts. It is thought by some to contain a small portion of oleaginous matter, and an absorbent earth, of a nature similar to limestone, with a large quantity of clay intermixed.

Lime mixed with clay comes nearest to the nature of marl of any factitious body that we know of, and may be used as such, where it can be had without much expense. By increasing the quantity of clay, it will make an excellent compost for a light sandy soil; but to make the ground fertile, woollen rags, rotten dung, curriers' shavings, or any oily manure, should be incorporated with it some time before it is laid on.

It is the opinion of some, that lime enriches the land it is laid upon, by means of supplying a salt fit for the nourishment of plants; but, by all the experiments than have been made upon lime, it is found to contain no kind of salt. Its operation, therefore, should be considered in a different light. By the fermentation that it induces, the earth

opened

opened and divided, and, by its absorbent and alkaline quality, it unites the oily and watery parts of the soil. It also seems to have the property of collecting the acid of the air, forming with it a combination of great use in vegetation.

From viewing lime in this light, it is probable that it tends to rob the soil of its oily particles, and in time will render it barren, unless we take care to support it with rotten dung, or other manures of an oily nature.

As light sandy soils contain but a small portion of oleaginous particles, we should be extremely cautious not to over do them with lime, unless we can at the same time assist them liberally with rotten dung, shavings of leather, woollen rags, shavings of horn, and other manures of an animal kind. Its great excellence, however, upon a sandy soil, is by mechanically binding the loose particles, and thereby preventing the liquid parts of the manure from escaping out of the reach of the radical fibres of the plants.

Upon clay the effect of lime is different; for, by means of the gentle fermentation that it produces, the unsubdued soil is opened and divided; the manures laid on readily come into contact with every part of it; and the fibres of the plants have full liberty to spread themselves.

It is generally said that lime answers better upon sand than clay. This observation will undoubtedly hold good as long as the farmer continues to lime his clay lands in a scanty manner. Let him treble the quantity, and he will then be convinced that lime is better for clay than sand. It may be justly answered, that the profits will not admit of the expense. I agree. But then it must be understood that it is the application, and not the nature of the lime, that should be called in question. Clay, well limed,

will fall in water, and ferment with acids. Its very nature is changed.

Under such agreeable circumstances, the air, rains, and dews, are freely admitted, and the soil is enabled to retain the nourishment that each of them brings. In consequence of a fermentation raised in the soil, the fixed air is set at liberty, and in that state of activity it becomes an useful instrument in dividing the tenacious clay. However, let the farmer, who uses much lime for his clay lands, be instructed to manure them well, otherwise the soil will bake, and become too hard to permit the roots of the plants to spread themselves in search of food.

It is the nature of lime to attract oils, and dissolve vegetable bodies. Upon these principles we may account for the wonderful effects of lime in the improvement of black moor-land. Moor-earth consists of dissolved, and half-dissolved, vegetable substances. It is full of oil.—Lime dissolves the one, and assimilates the other.

Such lands, not originally worth sixpence *per* acre, may be made, by paring, burning, and liming, to produce plentiful crops of turnips, which may be followed with oats, barley, or grass seeds, according to the inclination of the owner.——These observations, however, are rather foreign from the argument of the present essay, to which I shall now return.

To the universal principle, oil, (phlogiston,) we must add another of great efficacy, though very little understood; I mean the nitrous acid of the air.

That the air does contain the rudiments of nitre, is demonstrable from the manner of making saltpetre in the different parts of the world. The air contains no such salt as perfect nitre; it is a factitious salt, and is made by the nitrous acid falling upon a proper matrix. The makers

makers of nitre form that matrix of the rubbish of old houses, fat earth, and any fixed alkaline salt. The universal acid, as it is called, is attracted by these materials, and forms true nitre, which is rendered pure by means of crystalization, and in that form it is brought to us. In very hot countries, the natural earth forms a matrix for nitre, which makes the operation very short.

It is observed, that nitre is most plentifully formed in winter, when the wind is northerly: hence we may understand the true reason why land is fertilized by being laid up in high ridges during the winter months. The good effects of that operation are wholly attributed to the mechanical action of the frost upon the ground. Light soils, as well as the tough ones, may be exposed in high ridges, but with some limitation, in order to imitate the mud walls in Germany, which are found, by experience, to collect considerable quantities of nitre during the winter.

After saying so much in praise of nitre, it will be expected that I should produce some proofs of its efficacy, when used as a manure. I must confess that experiments do not give us any such proofs. Perhaps too large a quantity has been used; or rather, it could not be restored to the earth with its particles so minutely divided, as when it remained united with the soil, by means of the chemistry of nature. I shall therefore consider this nitrous acid, or, as some call it, the *acidum vagum*, in the light of a vivifying principle, with whose operation we are not yet fully acquainted.

I have already observed, that there subsists a strong analogy between plants and animals. Oil and water seem to make up the nourishment of both. Earth enters very little into the composition of either. It is observed, that animals take in a great many earthy particles at the mouth,

mouth, but they are soon discharged by urine and stool. Vegetables take in the smallest portion imaginable of earth; and the reason is, they have no way to discharge it.

It is highly probable, that the radical fibres of plants take up their nourishment from the earth, in the same manner that the lacteal vessels absorb the nutriment from the intestines; and as the oily and watery parts of our food are perfectly united into a milky liquor, by means of the spittle, pancreatic juice, and bile, before they enter the lacteals, we have all the reason imaginable to keep up the analogy, and suppose that the oleaginous and watery parts of the soil are also incorporated, previous to their being taken up by the absorbent vessels of the plant.

To form a perfect judgement of this, we must reflect that every soil, in a state of nature, has in itself a quantity of absorbent earth, sufficient to incorporate its inherent oil and water; but when we load it with fat manures, it becomes essentially necessary to bestow upon it, at the same time, something to assimilate the parts. Lime, soap-ashes, kelp, marl, and all the alkaline substances, perform that office.

In order to render this operation visible to the senses: —Dissolve one drachm of Russia potash in two ounces of water; then add two spoonfuls of oil. Shake the mixture, and it will instantly become an uniform mass of a whitish colour, adapted, as I conceive, to all the purposes of vegetation.

This easy and familiar experiment is a just representation of what happens after the operation of burn-baking, and consequently may be considered as a confirmation of the hypothesis advanced. Let us attend to the the process.

The

The sward being reduced to ashes, a fixed alkaline salt is produced. The moisture of the atmosphere soon reduces that salt into a fluid state, which, mixing with the soil, brings about an union of the oily and watery parts, in the manner demonstrated by the experiment.

When the under stratum consists of a rich vegetable mould, the effects of burn-baking will be lasting. But when the soil happens to be thin and poor, the first crop frequently suffers before it arrives at maturity.

The farmer, therefore, who is at the expense of paring and burning a thin soil, should bestow upon it a portion of rotten dung, or shambles manure, before the ashes are spread, in order to supply the deficiency of oily particles; and he should be very careful not to keep this kind of land too long under the plough.

In consequence of this prudent management, the crop will be supported during its growth, and the land will be preserved in health and vigour.

For such weak lands, it is highly probable that the oil-compost described in the next essay, will be found the cheapest and most effectual manure.

Hitherto I have considered plants as nourished by their roots. I shall now take a view of them as nourished by their leaves. An attention to this part of the vegetable system is essentially necessary to the rational farmer.

Vegetables that have a succulent leaf, such as vetches, pease, beans, and buck-wheat, draw a great part of their nourishment from the air, and on that account impoverish the soil less than wheat, oats, barley, or rye, the leaves of which are of a firmer texture.

In this manner the vegetable creation renders the air pure by assimilating to itself those putrescent particles which, if not removed, would render the atmosphere unfit for animal respiration. Some modern philosophers have

have attempted to destroy this opinion, but they must bring stronger proofs than those they have produced, before they can expect to tear from the human breast an idea so full of harmony.

Rape and hemp are oil-bearing plants, and, consequently, impoverishers of the soil; but the former less so than the latter, owing to the greater succulency of its leaf.

The leaves of all kinds of grain are succulent for a time; during which period the plants take little from the earth; but as soon as the ear begins to be formed, they lose their softness, and diminish in their attractive power.

The radical fibres are then more vigorously employed in extracting the oily particles of the earth, for the nourishment of the seed. Such, I apprehend, is the course of nature.

On the Advantages of distilling Ardent Spirits, and drying Coffee and other Substances by Steam; and Description of an Instrument for facilitating Evaporation. In a Letter from Mr. CHARLES WYATT *to the Editors.*

GENTLEMEN,

AS you thought my patent for distilling * by steam worth a place in your publication, I hope you will indulge me by inserting the following observations.

Having, by repeated and extensive experiments, clearly ascertained the great advantages resulting from the distillation of ardent spirits by steam, I would beg leave to submit, to the consideration of those who may be interested in

* See vol. II. p. 9, of the second series of this work.

in such pursuits, a concise view of what may be expected from a change in the present system of distilling.

The points on which this undertaking, compared with the existing practice, principally rests, are these.

1st. An improvement in the quality of the spirit.

2d. A facility and security in conducting the operation.

3d. A reduction in the labour, and in the duration, of the process.

4th. A reduction in the expense of fuel.

5th. A reduction in the original expense and repair of utensils.

I. *An Improvement in the Quality of the Spirit.*

A Committee of the House of Commons, which sat in the year 1799, to enquire into the state of the Scotch distilleries, reports, that the disagreeable and unwholesome flavour frequently discovered in spiritous liquors, arises from "*rapid distillation. The essential oils, and other* "*particles of an offensive smell and taste, rise in rapid* "*distillation with the spirit, and communicate to it their* "*peculiar flavour.*" In confirmation of this fact, some extracts will be made from the report, and annexed to these observations.

On considering the nature of distillation, it will be obvious, that, to obtain a pure and genuine spirit, no more heat should be applied than will detach the spirit from its basis; although, for the purposes of commerce, great niceties cannot be observed. But "*rapid distillation*" requires great heat. Great heat expels the essential oils, and other adventitious substances; burns the extractive matter that falls to the bottom of the still; and is thus the true source of the depravation of the spirit.

By using steam as the vehicle of heat, it is proposed to remedy these inconveniences. The heat, as applied in this apparatus, can never exceed that of boiling water; the liquor will be constantly attenuated by accessions of condensed steam; the extractive matter cannot be deposited nor burnt; the essential oils cannot in any undue proportion be expelled; and therefore the spirit will rise in a milder and purer state than by the immediate application of fire.

II. *A Facility and Security in conducting the Operation.*

The fire not being in contact with any of the distilling vessels, but with the boiler only, which, by a very simple contrivance, supplies itself with water during the operation, no danger is to be apprehended from any sudden increase of intensity in the fire, nor can it injure either the quality or ultimate quantity of the spirit. One particular convenience is, that the fire may be situated in a distant or an external part of the building.

III. *A Reduction in the Labour, and in the Duration, of the Process.*

To make this intelligible, it is necessary to observe, that the stills are double, *i. e.* one still is placed upon the other, and that steam is let into the lower, but not into the upper still. Both stills are to be charged at once. The roof of the lower still is so constructed, that every particle of steam, on being condensed against it, runs immediately into the refrigeratory; and the heat that evolves in that condensation, passing into the superior charge, prepares it for distillation. The lower charge being let off, the upper charge supplies its place, and begins almost immediately to run. If the upper still

contain

contain low wines, the operation will be partly simultaneous. Thus four circumstances concur to accelerate the operation.

1st. No significant time is lost in raising the liquor, the first charge excepted, to the boiling point.

2d. None of the steam that is raised within the lower still, returns in a liquid state into the general mass to be again raised.

3d. Whatever is obtained from the upper still during the simultaneous operation, is so much time of the common process curtailed. And,

Lastly, as no cake will form within, all the time usually required to cool and clean the stills, is here dispensed with.

In fifty successive distillations, the abridgement of the process cannot be so little as 150 hours.

IV. *A Reduction in the Expense of Fuel.*

This is a point of considerable importance. Three hundred pounds weight of Newcastle coal, will produce, from 550 gallons of melasses wash, undergoing two distillations, one puncheon of rum of 110 gallons, hydrometer proof. According to some reports from Jamaica, reports possibly not accurate, this is only one-fifth part of the coal consumed there to produce the like quantity of spirit *: The difference however, even if less in favour of the new system, cannot fail to be an object of solicitude not only to every cultivator of the sugar-cane, but to every manufacturer of ardent spirit. In Scotland,

* Where wood is used as fuel it is necessary to allow 1,089 lbs. of dry oak to 600 lbs. of Newcastle coal, as equal heats are produced by those respective quantities. Vide Thomson's Chemistry.

where the distillation is *urged* by every practicable contrivance, the waste of fuel is enormous.

V. *A Reduction in the original Expense and Repair of Utensils.*

It would be improper here, to state the cost of the apparatus, but it would amount to less money than is usually given for utensils of the common construction; and certainly, as the stills do not come into contact with fire, as no harsh nor destructive incrustation whatever, can attach itself internally to the metal, the decay, and consequently the repair, of the vessels, can hardly be a subject of calculation. It is probable that little or no expense may be incurred on that point, within twenty or thirty years, except for the boiler, which cannot be more than a septennical charge.

THE DISTILLERY in which the experiments leading to these conclusions have been made, is situated on Bankside, and may be any day examined. Some improvements also in other parts of the undertaking, may be properly noticed here.

The fermenting vats; the reservoir containing the condensers; the cisterns for receiving the spirit; are all constructed of brick, laid in, and faced with Roman Cement; and although upwards of 14,000 gallons of wash have been distilled, no perceptible injury has been communicated to any of them, nor have the stills ever been cleaned, except being washed out with warm water. In vats built of these materials, all liquors may be kept cooler than they can be in wood, and their durability is much greater.

Extracts

Extracts from the Report of the Committee of the House of Commons on the Scotch Distilleries in 1799.

"When the wines used for distillation are old, heavy, "or overcharged with thick substances, and a very fine "clear spirit is wished wished for, a quantity of pure "spring water is thrown into the still along with the "wine, and the essential oils must not be forced over in "too great quantities.

"The stills run off in about twelve or fourteen hours, "and when rectifying low spirits require from eighteen "to twenty-two hours. From experience and observa-"tion I have found that spirits are more disagreeable "and fiery when distilled with a great degree of heat "than when distilled by a more moderate one."

Mr. Gordon, of Xeres.

"They who assert that rapid distillation has no in-"fluence upon the taste or flavour of the spirit, either "try to deceive, or are ignorant of the art of distilling.

"Why do we distill fine and delicate liquors in balneo "mariæ? Because the heat is equal and uniform, and "cannot be increased by the vivacity of the fire."

Mr. E. G. I. Crooken.

"I am of opinion that the essential or flavouring oils "cannot be separated so well from the spirits of fer-"mented liquors or washes of any kind by rapid dis-"tillation as by slow distillation." *Dr. Joseph Black.*

"The more rapidly the distillation is carried on, the "more the spirits obtained by it will be infected with "essential oils, and other particles of an offensive smell "and taste, as well as with water or phlegm."

Dr. Ingenhous.

"I have

"I have no hesitation in asserting, thet rapid distilla-
"lation brings over a very strong deleterious spirit,
"containing empyreumatic oil, which is highly obnox-
"ious to the health of those who drink it."

Mr. William Bannerman.

"I have no doubt that spirits are more unwholesome if
"distilled very rapidly, than when distilled slowly, and
"with a gentle heat." *Dr. Skene.*

The Method of drying Coffee, consists, in exposing it, in a reticulated cylinder, kept in motion, to the action of air, warmed by means of steam *.

The advantages of this method, over stoves and barbacues, are presumed to be these.

1st. The cylinder may be charged with the coffee in its wet state. The draining will neither injure the metal nor the process.

2d. The air may be raised at pleasure to any degree of heat below 180°. No steam or smoke whatever, can intermix with the air.

3d. After having been gradually heated in the cylinder, the coffee may be exposed to a further heat of upwards of 200°, by being spread upon a steam-table.

4th. The steam or vapour escaping from the coffee, can never return upon it in the state of moisture.

5th. The metal, never being heated beyond the boiling point of water, cannot, like metals heated by the immediate contact of fire, impart any prejudicial effluvia to the coffee.

* Although the subjects of this paper have a relation principally to the West India plantations, yet it may be proper to add, that this method of drying coffee may, with little variation, be successfully applied to gunpowder, corn, and other substances, and perhaps to the making of malt.

Description

Description of an Instrument for facilitating Evaporation; invented by Mr. R. Vazie.

It consists of a hollow cylinder, caused to revolve slowly within a boiler, of correspondent form and dimensions. A common roasting jack may be so applied as to give motion to a number of these cylinders.

The principle on which this process is founded, although an imitation only of the natural action of cooling liquors by stirring, never having been applied to manufactures; it is thought that a statement of the result of some experiments, may tend to promote an improvement in the making of sugar.

Two equal vessels being filled with water, and exposed as nearly as possible to the same degree of heat, the cylinder was applied to one of them; and it was found, that the evaporation in this vessel exceeded the other, in the proportion of three to two, nearly. The heat of the agitated vessel was constantly about 170°, the other constantly 212°.

This indeed is no more than an illustration of the truth of the general theory of evaporation; and nothing new is pretended to be discovered on that subject.

But, a more important purpose than merely assisting evaporation, may arise from the use of this instrument in the manufacture of sugar. *The sugar cannot be burned;* and therefore, all discolouration proceeding from that circumstance would be prevented; nay, it is not improbable, but that the brown colour of Muscovado Sugar may be either removed, or much softened, by this process; and, it is pretty certain, that the grain of the sugar would be materially improved by it.

Lastly. As the process will be shorter than the customary mode, the consumption of fuel will be less. If

it

it should be in the ratio of the time, the saving will considerable; but on that point nothing certain can present be said. Experiment alone, can shew what is to be gained by this process; and it is presumed, that it would be impolitic to suffer any theoretical objections, to prevent an investigation, that may be attended with important consequences to the sugar trade.

CHARLES WYATT.

New Bridge-street, Sept. 1803.

Description of a Press for packing all Kinds of Goods with Expedition.

With a Plate.

From the ANNALES DES ARTS.

LIGHT, soft, and elastic substances used in commerce, as wool, cotton, hemp, flax, hops, tobacco, &c. require to be reduced into a small compass, to facilitate their carriage, and to preserve them from the humidity which they would not fail to contract by remaining in warehouses. Underneath will be found the description of a press, invented by M. Buschenderf, which is cheap, easy to be worked, occupies little room, and may not only be employed for packing the above-mentioned substances, but likewise for barrelling herrings and flour, for pressing bales of paper, oil-cloth, and many other purposes. This machine is intended to save the expense of metal vices and screws, which always come very high, or to obviate the necessity of wooden screws, which are very inconvenient when the wood is swelled with humidity, the operation being performed by the action of the lever

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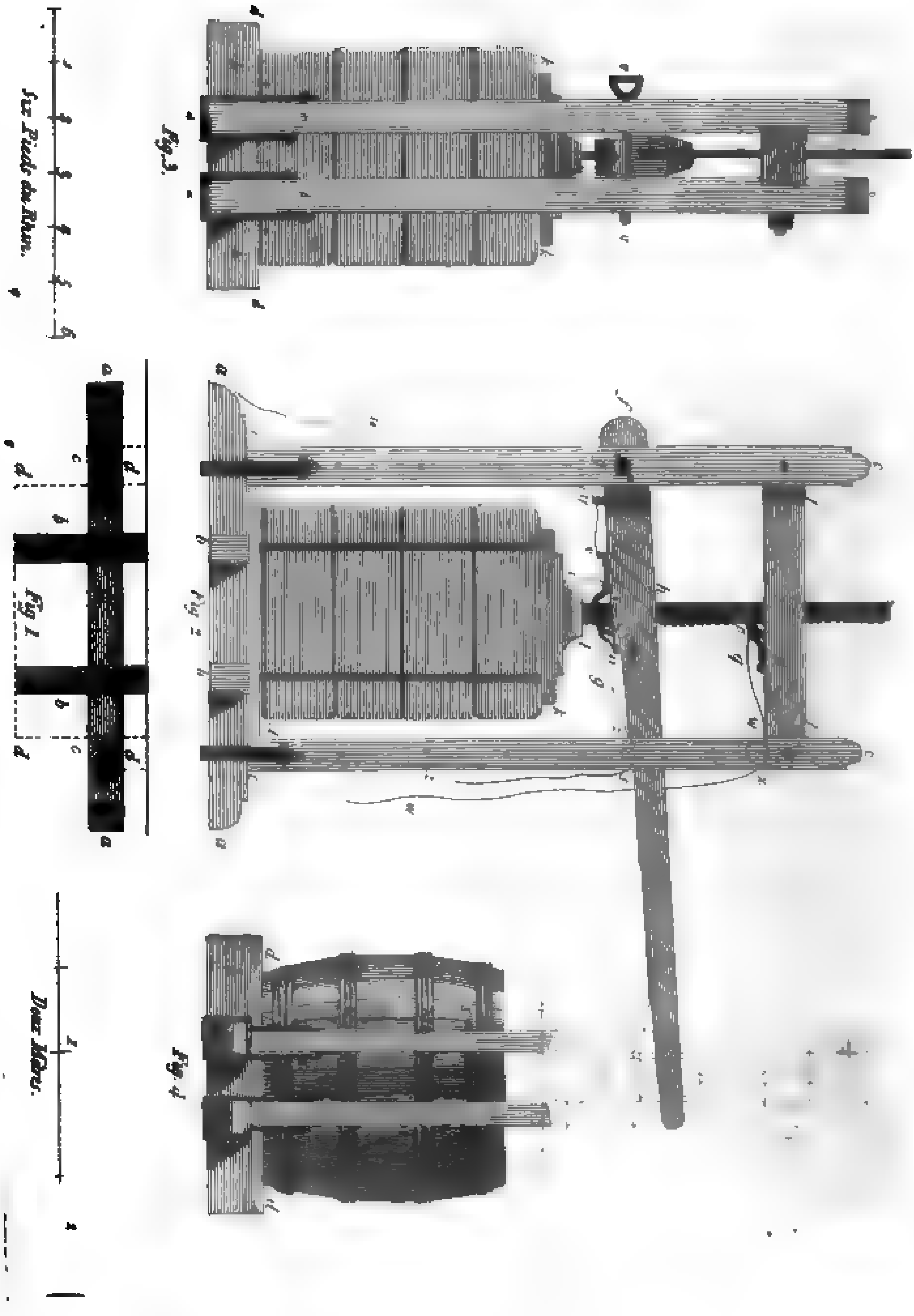

Six Pieds du Rhin.
Fig. 3.
Fig. 1.
Fig. 2.
Fig. 4.
Deux Mètres.

lever, the power of which may be augmented by increasing its length.

EXPLANATION OF PLATE XV.

Fig. 1, plan of half the press.

a a, the principal foot of the press.

b, *b*, cross beams fastened to the feet intended to form a solid frame for the bottom of the press.

c c, section of the two uprights.

d d d d, a square, shewing the bottom of the press, formed with thick oak planks, which cross the beams *b*, *b*. These planks must be sufficiently strong to resist the pressure.

Fig. 2, elevation of the press, longitudinally.

e, *e*, iron cramps, fastened with pins and screws, and intended to combine the uprights with the foot of the press.

f f, a lever, by which the pressure is effected.

g, a moveable pin, with a ring at the extremity, for the convenience of drawing it out; it serves as the centre of rotation of the lever. The uprights *c*, *c*, are perforated at certain distances, for the purpose of changing the position of this pin, as necessity may require.

h, a flat iron bar, cut on one side like a saw; the extremity is joined to a board or plate of metal, beneath which is placed a thick plank *k*, which is laid upon the goods.

l, an iron trigger, turning on the pin *m* (marked by a dotted circle), fixed in the lever *f f*. This trigger is pressed into the indentures of the saw by a spring *n*, that makes it catch.

 That

That the metal plate may not be raised by the elasticity of the materials exposed to the pressure of the machine, the beam *jj* is provided with a similar trigger *o*, turning on a pin *p*, which is made to catch by means of the spring *q*. This trigger prevents the saw-bar from going back when the lever has made it descend a few notches.

It is evident that the manner of working this press consists in the very simple operation of bearing upon the extremity of the lever, and in changing, from time to time, the moveable pin *g*, when its position is somewhat higher than horizontal. In pressing very elastic articles, as wool, &c. it will be proper to suffer the levers to remain stationary for some time. It is unnecessary to observe, that the bales or packages must first be placed properly, together with the cords with which they are to be tied. When the article has been sufficiently pressed the lever is lifted up at *r*, and held in that position, while an iron pin *s* is passed through the holes of the upright on the side opposite to the moveable peg: the position of this pin is seen at *s*, Fig. 4. To disengage the triggers, draw the cords *z z* and *w w*, which are carried over two small pullies; one of them, *x*, is placed beneath the cross-beam, and the other near *s*, under the lever. Their ends are fastened to two small staples, joined to the triggers *l*, *o*, and their springs *n*, *q*; these cords are tied to the moveable pin, while the plate is taken away, and the operation performed. But as these triggers or catches would not keep the flat plate and the saw-bar at a proper height, a flat bolt *t* is fixed behind the bar, provided with a small spring, which drives it into holes, made at proper distances in the back of the bar. A small cord *u*, carried through a staple *y*, and fastened

fastened to the head of the bolt *v*, serves to draw it out at pleasure when a fresh pressure is required. Thus the mere alteration of this bolt is sufficient to keep the saw and the plate at the proper height when the lever is to be lifted up by the manœuvre just described.

Fig. 3, elevation of the machine from behind; where may be seen the manner of fixing the cramps which join the uprights and the sleepers, and likewise the disposition of the lever and its pin: the same letters correspond to the same parts in all the figures.

Fig. 4. The machine is here seen properly disposed for the pressure of barrels of flour, herrings, &c. For packing casks it is necessary to have a strong round piece of wood, nearly the diameter of the barrel, which is placed above the head, and underneath the flat plate: this disposition facilitates the hooping when the head is pressed down to the notches.

The mortise made in the lever, for the passage of the saw, should be wider towards the top and bottom, to facilitate the movement of the lever, and always in the direction of a radius diverging from its centre of rotation. This mortise might even be provided, in case of necessity, with an iron cramp, or plate, to strengthen the lever: the teeth of the saw should not be cut with an angle too acute, that the catch may take better hold. It would not be amiss to secure the lever round the moveable pin with an iron cramp, to prevent its splitting.

Description of a new Photophorus, or Lamp.

With a Plate.

From the Annales des Arts.

FOR several years natural philosophers have directed their attention with considerable success to the means of economizing heat, by extracting the greatest possible quantity from a given quantity of combustible. It is not less interesting to apply this principle of economy to the employment of light, of which a considerable loss is daily sustained when a light is required to be cast on only one or more objects *.

It has indeed been long known, that parabolic mirrors possess the property of reflecting parallel with the axis, the rays of light that issue from the focus. The knowledge of this circumstance was connected with that of conic sections, but before M. Berard nobody ever constructed a lamp on these principles, at once simple, convenient, cheap, economical of the combustible, affording an equal and steady light, the direction of which may be varied at pleasure, and not fatigue the sight.

Every one is acquainted with that kind of reverberators in the form of a truncated cone, placed above the light, so that the axis of the cone may be vertical, and that the smoke of the light which is in this axis may escape by the small aperture at top. These reverberators produce little effect, for the reasons that will presently appear.

Lambert, in the Memoirs of Berlin for the year 1770, has given the description of a very imperfect reflecting photophorus

* We should imagine the author of this paper to have been ignorant of the excellent experiments on this subject made by Count Rumford, and published in the fourth volume of the first series of this work.

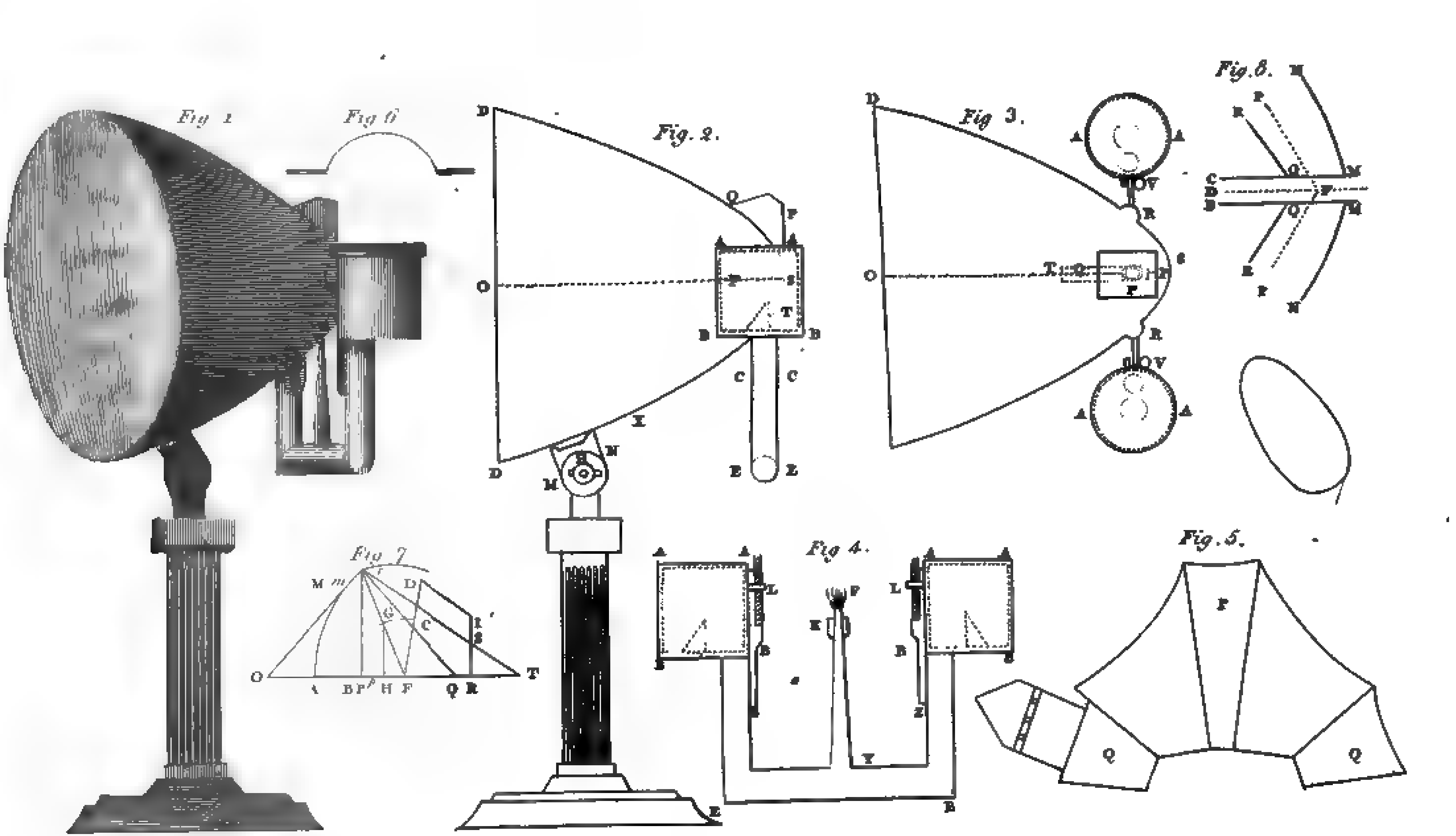


Fig 1
Fig 6
Fig. 2.
Fig 3.
Fig. 8.
Fig 7
Fig 4.
Fig. 5.

photophorus. M. Berard, in a photophorus of his own invention, has corrected all the defects attributed to that instrument: for, while meditating on the means of perfecting Lambert's lamp, his ideas were naturally directed towards the paraboloïd, which surface, as we know, possesses the exclusive property of reflecting parallel with its axis the rays which proceed from its focus. Such is the ground-work of his invention.

Explanation of Plate XVI.

Fig. 1, represents the paraboloïd in perspective, exhibiting three distinct parts: 1, a paraboloïd formed by the revolution upon its axis of a parabola, the parameter of which is 54 millimetres (2 inches), and the length of the axis 150 (or 5 inches 6 lines); 2, a candlestick or pedestal supporting the paraboloïd; 3, the reservoirs and channels for the oil, consisting of two cylindrical boxes, which contain two others, and two vertical pipes communicating with the boxes by means of another horizontal pipe, from the middle of which rises a small vertical pipe for the wick; this last runs into the interior of the paraboloïd, so that the centre of the flame always coincides with the focus.

To this sketch we shall add the following particulars.

1. The paraboloïd, at the two extremities of its parameter, has two small horizontal axes R, R, Fig. 3, round which the lamp, properly so called, balances itself by a rotatory motion.

2. The paraboloïd has in its lower meridian a groove or crevice T X, Fig. 2, through which passes the pipe with the wick in its oscillations round the axis R R, and in its upper meridian a hole P Q, by which the smoke is conveyed into a chimney, which opens upwards by means of a hinge 2.

3. The

3. The paraboloïd is fixed to the candlestick by a flat hinge fastened with a screw H, by means of which the direction of the light may be varied at pleasure.

4. The vertical pipes of the lamp have two channels, by means of which the lamp is raised in order to snuff, to light, or to extinguish the wick, by sliding the extremities of the axes upwards in these channels L, Z, Fig. 4, which pushes the wick through the hole of the chimney.

We shall now consider separately each of the pieces composing these principal parts.

The parabolic mirror is the principal and the most important part: there are several processes for making it.

First Process. A conical and truncated zone is made and soldered upon a parabolic mould. The zone is then beat cold, till the whole coincides with a parabola cut in wood or pasteboard, which is very easily procured. To form the zone, take a sector of 129° in a circle, the radius of which is 260 millimetres; take from it a concentric sector, of a radius of 150 millimetres; there will then be left a portion of a circular plain crown, which, being bent back, forms the conic zone. This is soldered to a parabolic cap, the aperture of which is 109 millimetres, coinciding with that of the zone, and whose arch is 54 millimetres. In this first process plates of brass or tin, about a millimetre in thickness, are employed.

Second Process. Procure a circle of brass, a millimetre and a half thick, and about 250 millimetres in diameter, to be wrought by a coppersmith. If the copper be without flaw, and of the proper quality, the interior of this paraboloïd of a single piece may very easily be made to coincide with a parabola cut in wood.

In

In this second process, as well as the first, the mirror is polished successively with pumice-stone, charcoal, tripoli, and rotten stone: the polishing is soon performed: the mirror when finished weighs about 6 hecto-grammes (a little more than a pound). For this second process copper may likewise be employed, as it is much easier to beat out than brass, but in that case the mirror must be silvered. This kind of mirror is always preferable when they are required to be of large dimensions.

Third Process. The best method of making the mirror would doubtless be, to cast it of the composition used for the mirrors of telescopes, or rather of platina. More powerful effects would certainly be obtained from such mirrors, but they would be too expensive for an instrument for common use, and very inconvenient on account of their weight.

If the mirror is not intended to be of larger dimensions than those stated above, the process of casting may be employed to advantage by using brass, which, being less brittle, requires less trouble in polishing, and may be reduced by turning to a proper thickness.

The two first processes are preferable, being less expensive, when only one or two mirrors are intended to be made; but the third is better for making a greater number.

There is one observation which applies equally to the three processes: that though accuracy be required in the curvature of the mirror, yet the highest degree of perfection in this curve is not absolutely necessary. As it is only desired to unite within the compass of a cylinder the rays emanating from a luminous point to direct them to an object not very far distant, we may be sure that a small defect of parallelism in a ray will not prevent it from falling upon some part of the object that is intended

to

to be lighted. The same is not the case in the inverse proposition as in the burning glass, to unite the parallel rays in the smallest possible space; here the highest perfection in the curve of the mirror is indispensable to produce the desired effect.

The mirror being completed, trace on the convex surface, with a pasteboard rule, two meridians, intersecting each other at right angles at the south pole, which must previously be determined: these two meridians, which are easily traced by means of a circle and two perpendicular diameters drawn upon a table, fix the position of the chimney P Q, the hinge M N, the groove T X, and the axes R, R, which are prolongations of the parameter. Let us consider each of these parts separately.

The aperture P Q, made in the paraboloïd for the passage of the smoke, should be as small as possible, and yet sufficiently wide to preserve the mirror from the smoke in every position. If we suppose that the smoke never diverges more than in an angle of 15°, and then imagine a cone, with an aperture of 30°, whose top is in the focus of the mirror, and its axis in the prolongation of the wick; this cone, penetrating the paraboloïd in these different positions from where its axis is horizontal to where it is inclined 35°, will form an aperture of an oval figure, which widens from the pole, as in Fig. 6: it begins at 9 millimetres from the pole S; it is in length 38 millimetres, its greatest breadth is 18, and its smallest 11 millimetres.

The aperture of the mirror is covered by the chimney, properly so called, which has the form of a quadrangular, truncated pyramid; the base is a trapezium, one side of which is 25 millimetres, the parallel side 18 millimetres, and the two others, which are equal, are together 44 millimetres. The superior base is a trapezium, one side of which is 9 millimetres, the parallel side

side 5 millimetres, and the two others being equal, are together 16 millimetres. At Q this pyramid has a tail, terminating in a hinge, on which it turns upwards. Fig. 5, exhibits a developement of this pyramid, made in a single piece, and which bends so that the two edges Q, Q, fold over each other. The right angle of the lower base has rather concave sides, to fit the paraboloïd exactly.

The form and dimensions of this chimney are so contrived as to collect the smoke in its centre, and to preserve the mirror from it in every position: it prevents all agitation in the circum-ambient air, preserves the intensity of the flame in a remarkable manner, by producing a current of air from top to bottom. When the axis of the paraboloïd is horizontal, the side Q of the chimney is inclined about 45°; and when the axis is inclined 35°, the side P is likewise inclined 45°, so that in the two extreme positions the smoke is always driven to the centre of the chimney. If this were not the case, the photophorus would lose all its advantages.

To fix the two axes R, R, which are prolongations of the parameter, and which serve as a pivot to the lamp; the two points R, R, which are the extremities of the parameter, and are distant from the pole 31½ millimetres, more or less, according to the thickness of the copper, must be exactly marked by means of a wooden ruler, in which must be cut a portion of the parabola, forming an arch of 13½ millimetres, exclusive of the thickness of the mirror at the pole. A piece of iron wire, 3 millimetres in diameter, must then be bent, so that after passing round the outside of the parabola its two extremities may be in a right line, as in Fig. 6. This iron wire being soldered at the two points R, R, already found, the curved part is cut off. Lastly, to render the two axes

axes more solid, they may be inclosed in a small spherical segment R, likewise soldered to this paraboloïd.

The magnitude, figure, and position, of the aperture T X, which the pipe with the wick passes through, are determined by the penetration of this pipe in the various positions of the mirror. Its length T X is 68 millimetres, its distance T S from the pole 27, its least width 7, and its greatest width 11; it is rounded at its two extremities.

The flat hinge H is composed of two rectangular pieces of copper, 27 millimetres in breadth, 40 in length, and 2 thick, and a circle of the same thickness, and 27 millimetres in diameter. The two rectangular pieces terminate on one side in semi-circles, and on the other are bent into a right angle, the contrary way, so as to form a base M N, which is soldered to the paraboloïd. The two rectangular pieces fit close to the circle, which terminates in a cylindrical or somewhat conical tail, which enters the hollow of the candlestick, whose height is 160 millimetres, and its diameter at the base 140 millimetres. A screw with a square head goes through the three parts of the hinge at their common centre.

A line, passing between the two rectangular pieces of the hinge, ought at the same time to go through the middle of the aperture T X, and of the chimney P Q, as also through the axis S O of the paraboloïd. In fixing the screw the greatest attention must be paid that in every position of the paraboloïd the parameter R R, and consequently the reservoirs of oil, remain horizontal.

The distance, M D, from the base to the aperture of the paraboloïd is 27 millimetres: if this distance were augmented, the hinge would injure the horizontal pipe E E, at the extreme inclination of the paraboloïd. On the other hand, if M D were smaller, the centre of gravity

gravity of the photophorus would be too far distant from the axis of the chandelier, and there would be less stability in the machine; besides, the pole would be too far from the axis of the chandelier, and the pole of the paraboloid would be more liable to injury on the chimney-piece of an apartment.

A A, B B, Figs. 3 and 4, are cylindrical boxes, of block-tin, being 45 millimetres in diameter, and the same in height. These boxes, which have no tops, contain two others; between the two there is a vacancy of a millimetre, intended to promote the current of air, and between the bottoms is a vacancy of 4 millimetres. In the centre of the bottom of the exterior box is fixed vertically an iron spike, 14 millimetres in length. The bottom of the inside boxes has a hole, 15 millimetres in diameter: this hole is covered by a tin plate, covered with lead, and which opens by a small hinge, to an inclination of 60°: it is lifted up by means of the iron spike.

The bottoms B, B, of the outside boxes, communicate with the two vertical pipes B E, B E, which are 13 millimetres in diameter, and 81 in length. These two pipes are soldered to the reservoirs in such a manner that the respective surfaces exactly meet at B, and that no projection may prevent the passage of the fluid from the reservoirs.

To the extremities E, E, is soldered, at a right angle, another pipe, of the same diameter as the preceding B *e*, the length of which, measured between the two, is 100 millimetres.

In the middle of the pipe E E rises vertically the pipe Y, with the wick. It is somewhat conical; its diameter at Y is 7 millimetres, at the upper end 3 or 4, according

to the thickness that the wick is intended to be. The top is elevated 23 millimetres above the bottom of the reservoirs B, B; the whole length to Y is 88 millimetres.

K, is a double pipe, 11 millimetres in diameter, and 7 in height, which envelopes the end of the pipe with the wick, so as to leave a vacancy of a millimetre between them; its top is not so high by two millimetres as that of the pipe with the wick. The object of this double pipe is to collect the oil which the heat may cause to run down the pipe with the wick, and to lead it back into it by means of one or two small holes made in the latter, and which communicate with the vacant interval. This contrivance saves the oil which runs from the wick; an inconvenience to which most lamps, and even those with a double current of air, are liable.

The vertical channel L Z is formed of a plate of iron, 5 millimetres broad and 154 in length; it is bent in such a manner as to leave a hollow of three millimetres between its two parallel but unequal branches, the longest of which is level with the top of the boxes, and the other commences 9 millimetres lower down: the longest branch was at first 9 millimetres wide by 27 long; this part is afterwards twisted in the form of a screw, upon which is put a small nut F, which moves up and down, bearing on one side against the reservoir, and on the other the smaller branch of the pipe: it is by these nuts that the lamp rests upon the axes R, R, of the paraboloïd.

The following is the manner of using the photophorus.

Supposing the different pieces of the machine are separate, the first point is to put them together.

1. Introduce the stalk of the hinge H into the hollow of the candlestick.

2. Introduce

2. Introduce the circle joined to the stalk into the cavity formed by the two pieces M, N, fixed to the mirror, and screw them together with the screw.

3. Introduce the upper end of the pipe with the wick into the lower extremity X of the aperture T X; and in placing the lamp, which must be held by the horizontal pipe, put the two axes R, R, into the channels L, Z, then lower the screws L, L, till the extremities of the axes R, R, correspond at about 13 millimetres below the top of the boxes.

4. Make a wick of cotton, or other substance; fasten one end of it to a piece of wire, by which means it may easily be introduced into the pipe that is to receive it.

5. Into the reservoirs *a*, *b*, pour nut or olive oil till the vertical pipes are full; afterwards fill the inner boxes, introduce them gently, and both together, if possible, into the reservoirs. At this moment, the iron spikes having raised the tin plates which cover the holes at the bottom of these boxes, a small quantity of oil will run between the box and the reservoir to the height of some millimetres. As the wick burns the oil descends till it comes to be level with those plates. A few bubbles of air then introduce themselves through the aperture, and ascend through the oil in the boxes, to occupy the vacant space. The addition of these bubbles augments the power of the rarefied air contained there, and makes fresh oil run through these apertures till an equilibrium is established between the external air and that inclosed above the oil; this operation continues till all the oil in the boxes is consumed.

6. When the lamp is provided with cotton and oil there is nothing more to be done than to light the wick; for this purpose, after having raised the lamp vertically till

till the pipe with the wick rises through the aperture of the chimney, it is then lighted, and let down in the same manner. In this movement the axes R, R, run freely in the vertical channels.

7. When the wick is lighted it is necessary to examine whether the centre or principal point of the light coincide with the focus *f* of the paraboloïd. This is very easily effected, by turning the screws till the light is as lively and as equal as possible. The position of the screws when once found cannot vary, at least not perceptibly, as long as the burning portion of the wick does not alter in length or thickness. The length ought not to exceed 6 millimetres, that it may not be consumed too rapidly.

8. In order to snuff or extinguish the match, the same operation is necessary as for lighting it.

9. To use the photophorus, the proper inclination must be given to it according to the distance at which we want to read or write. The axis of the paraboloïd may form an inclination of 35 or 40 degrees with the horizon.

10. Care must be taken to wipe the mirror frequently with a linen cloth, and to clean it sometimes with dry whiting, or rather with rotten stone. The pipes for the oil must likewise be cleansed with ley of ashes; and a wire must be passed between the pipe for the wick and the double pipe fixed upon it to clear out the snuff that may insinuate itself, and occasion the oil to run over.

11. When the lamp is to be removed from one place to another, and is lighted, in order to prevent the flame from blackening the mirror, raise the flame into the chimney.

Of

Of the Effects and the Advantages of the Photophorus.

Those who recollect the defects that we observed in Lambert's photophorus, will see that they have all been avoided in the construction of that above described. The following are its effects.

1. The intensity of the light is much greater than in Lambert's photophorus. With the present a person may read a book at the distance of twenty metres (yards), while, with the same light, the same character cannot be read at a greater distance than half a metre.

2. The reflected light is of the same colour as the direct light, if the mirrors be silvered: if they be of copper, the reflected light is rather yellow, which however is not disagreeable to the eye. The former do not tarnish so soon, but if they be rubbed the silver quickly comes off: the second are more easily oxydated, tarnish more readily, but the polish may be renewed as often as we please with rotten stone.

3. The light is equal and uniform at the distance of a metre: at the aperture of the mirror, indeed, are observed several concentric circles, more or less luminous, and in the middle a small bright spot; but these circles soon disappear, and at the distance of two or three decimetres there remains only the bright spot; and the light afforded by it is of the most lively and agreeable kind.

4. The facility of varying the direction at pleasure is an important advantage which renders the photophorus more extensively useful.

5. The solidity of the light is such that the flame never quits the vertical position; and I have observed that the undulatory motion of the light in most other lamps is extremely injurious to the sight.

6. The

6. The paper being the only object in the room upon which the light falls, the retina is sensible only to the impression produced by the paper; hence it results, that the effect of the light is in fact augmented, and that the eyes are less fatigued. It is by a similar effect that a light, which cannot be perceived in the day-time at the distance of a few metres, may be seen at night at the distance of a myriametre, and that any object may be seen better by looking at it through a long black tube, though without glass, than by the naked eye.

7. The expense of oil for this lamp is less than for others, for many reasons: the reservoirs contain about 120 grammes (4 ounces) of oil, which last twenty-four hours without the necessity of a fresh supply, or even of touching the lamp.

Utility of the two independent Movements in the Photophorus.

We might be tempted to simplify the mechanism of the photophorus by making the lamp immoveable on its pedestal, and making the paraboloïd turn round its parameter. There would indeed be one movement less, and consequently more simplicity, but the gain would only be illusory, and we should lose an inestimable advantage, which is obtained by the movement of the axes in the channels, that of being able to light, extinguish, and snuff the wick on the outside of the mirror.

Of Cases in which the circular Wick may be adapted to the Photophorus.

It would not be difficult to adapt to this lamp a circular wick, surrounded with a glass tube, as in Argand's lamps. The following are the inconveniences with which it would be attended: all the points of the flame not be-

ing

ing at the focus, the rays would not be kept parallel; there would be a greater consumption of oil, less facility in snuffing, lighting, extinguishing, &c.; but these disadvantages would diminish in proportion to the magnitude of the mirror: thus when the photophorus is intended to light a great space, as a corridor, a gallery, &c. it would be proper to adapt to it the circular wick, &c. The proportions of the mirror ought in this case to be different; its parameter should then be about 100 millimetres, its diameter 200, and the pipe for the wick should be 12 millimetres in diameter.

Property of double Reservoirs, to prevent the Loss of Oil by the Wick.

By the disposition of the reservoirs, with regard to the wick, the latter is placed exactly in the centre of all the oscillations which the oil experiences by the vibration of the lamp in every direction, so that the level of the oil does not change in the pipe for the wick, though it varies in the reservoirs. This property, which belongs exclusively to the lamp with double reservoirs, is extremely useful to prevent the loss of oil by the wick. This advantage would not exist if the reservoir were in one piece, and surrounded the mirror in a circular form; the oil would then run over at the wick upon the smallest agitation of the photophorus, which would likewise be more inconvenient on account of its augmentation in size at the pole.

Method of using the Photophorus like a common Lamp.

The photophorus may be employed in lighting any apartment like a common lamp; for this purpose it is sufficient to raise the wick above the chimney, as if to

 light

light it, and to keep it in that position by means of a small catch. In this manner it may also be used for warming a coffee-pot, standing on two bars of iron-wire, supported by the reservoirs.

From the experiments made before the Conservatory of Arts and the Council of Mines, it appears that the photophorus, in its present state of simplicity and perfection, is susceptible of numerous applications. It is useful to the man of letters, the artist, and all those who read, write, draw, or are employed in any other occupation by night. It is of particular advantage to those who are fond of reading in bed. Its utility will be found very great for embossing, by its throwing a stream of light upon the work in any given direction. It may be employed with economy in lighting corridors, and particularly the galleries of mines, at the bottom of which common lights expire when they have consumed all the surrounding oxygen gas; for the photophorus may be fixed in places where the air can be renewed, and directed to any side at pleasure. Its application will be found serviceable in all manufactories where a number of workmen are employed in a row.

The above description was necessary to explain the following letter of the inventor, M. Berard, to the editor.

I have given the description of a photophorus, affording an equal and steady light, by which a book may be read at the distance of 20 metres with a wick consuming only 125 grammes (4 ounces) of oil in twenty-four hours.

As that instrument can light only one person, or several placed in a right line, I have since endeavoured to discover the most convenient form for lighting equally, and at the same time, several workmen, placed in a circular

cular manner. The following has appeared the most simple and effectual.

Fig. 8 represents the vertical section through the centre of the photophorus. M N, M N, are two portions of the parabola, which have a parameter of 80 millimetres, a common focus at F, and axes F P, F P, 200 millimetres in length, forming between them an angle of 110 degrees.

Q R, Q R, are two other portions of the parabola, having the same focus and the same axes, but whose parameter is only 20 millimetres.

This being the case, if we consider that the four parabolas turn round the line F D like an axis, the two parabolas M N, M N, will, as they revolve, describe a figure like a flat bowl, and the two others Q R, Q R, will form another surface nearly of the figure of a cone.

Let us now suppose these two surfaces of tin, brass, or rather of silvered copper, are each fixed in their respective positions by three small supporters, and that through the two apertures M M and Q Q made in the centre, a candle or wick has been introduced, it is obvious that when the machine is placed vertically over the centre of a round table, all the rays reflected by the two mirrors will form on the table a ring or circular crown of light, around which the people at work will enjoy an equal portion of reflected light.

This photophorus, which may be called circular, since it unites all the rays into a circular form, while the rest of the apartment is half obscure, may be adapted to every round table of any magnitude, by being raised more or less above the table.

Ellipses may be taken instead of parabolas as the curve for forming the two mirrors; the luminous ring would

 be

be smaller, and the light would consequently be more intense; but, on the other hand, the same photophorus could not be advantageously adapted to tables of various dimensions. This inconvenience caused me to prefer the parabola to the ellipsis; I only made the lower parabolas Q R, Q R, of a smaller parameter, to diminish the magnitude of the illuminated zone.

Notice on a Method of giving to Hemp and Flax the Appearance of Cotton. By M. BERTHOLLET.

From the JOURNAL DE L'ECOLE POLYTECHNIQUE.

WHEN I turned my attention to the application of oxygenated muriatic acid to the art of bleaching, I made experiments with it upon flax and hemp, and in the first volume of the Elements of Dying, page 258, I spoke of it in the following terms: "I endeavoured to bleach, completely, hemp and flax, in a state ready for spinning, by the method that I employ for thread; but though its filaments lose little of their solidity, yet they acquire so great a disposition to separate and divide, that they are much more difficult to spin, and make a much weaker thread."

Since that time, different artists have endeavoured, with more or less suceess, to extract from hemp and flax a material resembling cotton. An Helvetian, M. Clays, has even for some time possessed an establishment in which he prepares this material.

I am ignorant of the processes which have hitherto been employed, but, by means of the oxygenated muriatic acid, I have succeeded in obtaining a material more

more beautiful than any of those with which I am acquainted.

The very simple process which I am going to describe was executed in the laboratory of the Polytechnic School by M. Gai Lussac, then a pupil of that school.

The hemp or flax is cut into fragments of about six centimetres in length, and covered with water, in which it is left three or four days. It is then subjected to ebullition in clear water, washed with care, passed through ley, and likewise through oxygenated muriatic acid. Four immersions in oxygenated muriatic acid, and four leys, are commonly sufficient; after which it is passed through a water-bath, in which are mixed a two-hundredth part of sulphuric acid. When taken out of this warm bath, in which it is left about half an hour, it is washed with great care, and immersed in water charged with soap: it is then spread out, without being wrung, on hurdles, where it is left to dry, but not entirely. All these operations, from the first immersion to desiccation, require only five or six hours for a small quantity.

The hemp and flax thus prepared was given to M. Molar, who engaged to perform the mechanical operations. By him it was first combed and then carded. He experienced some difficulty on account of the knots that were formed; but that able mechanician soon surmounted this obstacle.

On the 6 Prairial, year 8 (1800), I presented to the class of physical and mathematical sciences of the Institute, a specimen of the prepared material, equal to cotton in whiteness, and other apparent qualities; but M. Molar found fault that it was too short.

M. Bawens has likewise wrought the cottonny material prepared in the laboratory of the school, by means of

of the capital machines at his manufacture of Chaillot. He experienced no difficulty in the execution; but he likewise found the filaments too short, though it made thread of extreme fineness, and sufficiently strong.

It is therefore the inconvenience of being reduced into too short filaments, that ought to be corrected in the first preparation; and I think a certain method of doing it is not to finish the bleaching, but to stop at the third operation. If four be required to finish the bleaching, the fourth must be performed on the thread, or on the stuff.

In the operation of bleaching, the leys must not be applied too strong, but they should be employed boiling hot. We are assured, that every method of diminishing the smell of oxygenated muriatic acid weakens its action; so that it must be employed pure, and no attempt must be made to prevent the smell but by the construction of the apparatus, and the mode of application; it must even be used in a state of concentration, if we would not be obliged greatly to multiply the operations.

The process is completed by immersion in water charged with soap, without wringing, that the filaments may not contract too much adhesion by desiccation, but may be easily separated by the operation of carding. But, probably by preventing too great desiccation, this inconvenience, experienced in the first trials, would not take place, and this immersion might be dispensed with.

It is remarkable, that whether the finest flax or the coarsest hemp-tow be employed, filaments equally fine and white are obtained.

This notice will be a sufficient guide for bleaching, to artists already accustomed to chemical manipulations.

But

But I can say nothing respecting the mechanical operations of carding and spinning, as they were not executed by me.

If I am not mistaken, this application of a process, which is already old, may afford great advantages, since the spinning, which before required a wheel, may be performed with much less expense, by means of machines, while a gross product of our agriculture, even the refuse of rope-walks, may be converted into a substance precious for the arts. This is the motive which has induced me to insert this notice in the journal of an institution peculiarly devoted to public utility, though it contains nothing new in a scientific point of view.

Transactions of Societies for promoting useful Knowledge.

Society of National Economy of Harlem.

At a general meeting of this Society, the following prize questions were proposed.

What kind of nettle can be employed in making thread? The memoir must mention the country which produces it, the time of gathering, and describe the method of preparation. It must likewise be accompanied with twenty-five pounds of thread made of that plant. The prize will be 25 ducats, and it will be augmented if 50 lbs. instead of 25 be presented to the Society.

The subject for the second prize is, Can the acorn be employed in domestic economy, for making oil, as a substitute for coffee, &c. and what is the best method of preparing it? The prize is six ducats.

The third question is, What is the present state of public and private economy in Holland?

The

The fourth relates to the best method of preventing or curing the rot in sheep. The prize is 25 ducats; and 50 for the person who shall point out the cause of this disease, and the method of preventing it. All the above memoirs must be transmitted to the secretary of the Society before 30 September, 1804.

Millet being little cultivated in Holland, as no good method is yet known for separating it from the chaff, the Society offers a prize of 25 ducats to the inventor of a machine proper for that operation, and by means of which the millet can be as well separated as that imported from other countries. The competition will remain open till 30 September, 1805.

Society of Rouen.

The account of the public meeting of the Society of Sciences, Literature, and Arts, held at Rouen on 29th June, among other interesting subjects, contains the following.

1. Comparative experiments on the consumption of wood in the furnaces of dyers and others with that of furnaces on the new construction, in which the economy of fuel has been successfully attempted. M. Hæner, of Nancy, appears to have completely fulfilled this aim in the construction of furnaces in his porcelain manufactory.

2. A memoir on the disadvantages of spreading lime as manure on clover, and the injury sustained by young horses that are fed with such clover.

3. Another memoir, on lime considered as forming a cement impenetrable to water or any liquid.

4. A memoir on the methods of driving piles with much less exertion than by those hitherto in use.

5. Observations on bees and silk-worms, and the advantages attending their culture.

Economical

Economical Society of St. Petersburg.

The following are the prize-questions proposed by the Economical Society of St. Petersburgh for the year 1803.

1. By what means can a spirit of activity and industry be excited among the people, particularly the wives and children of the peasantry, in order to encourage the habitude of the labours necessary for their wants? The prize is a gold medal of 50 ducats, founded by the minister and privy counsellor Dmitri Prokosiewitsch Trochtschinskoi.

2. How can the poor in the hospitals of Russia be usefully employed, so that, if they be fed according to the principles of Voght and Rumford, they may be enabled to earn something in addition by labours useful to the state or to the soldiery? The prize is a gold medal of 30 ducats, given by Count Dmitri Iwanowitsch Chevostoff.

3. To propose a good method, suited to the capacity of the Russian peasant, for the preservation of his health, and to enable him to apply remedies himself in most indispositions; or an elementary work on health, for the common people of Russia, pointing out the best preservatives, extracted from indigenous plants, their preparation, and the manner of employing them. The prize is a gold medal of 50 ducats, given by the Senator Mich. Nikitisch Murawieff.

4. What means can be employed to induce the Russian peasant to learn a handicraft business, in which he and his family might be usefully engaged during the winter? The prize consists of a medal, presented for this purpose by the Catholic Metropolitan Stanislaus Sestrenzewitsch.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Explosion of a Steam-Engine.

ON Thursday, the 15th instant, a steam-engine, erected by Messrs. Vivian and Trevithick, near Woolwich, suddenly blew up, and laid the whole of the buildings in ruins. Three men were killed on the spot, one of whom was thrown 170 feet; of two others who were wounded, one is since dead, and another, who was returning to his work, lost his hearing for several hours. A piece of the boiler, 4 cwt. was thrown 350 feet, and some of the bricks 600 feet from the furnace. The cause of this accident has not been ascertained, but it was probably owing to the over-loading of the safety-valve. It was a double engine, of about eight or ten-horse power, four-feet stroke, and ten-inch cylinder. The boiler was of cast-iron, five feet six inches diameter, its average thickness about one inch and a quarter.

Method of preserving Metals from Rust.

M. Conté has discovered a method of preventing the oxydation of iron and steel, or, in the language of common life, to prevent those materials from rusting. This method consists in mixing with oil-varnish at least one-half, or at most four-fifths, of highly rectified spirit of turpentine, according to the greater or less degree of durability that is intended to be produced by it. This varnish is lightly and equally applied, with a sponge, to any article, after which it is put in some place out of the dust. It is asserted, that articles varnished in this manner preserve their metallic lustre, and never contract the

smallest

smallest spot of rust. This varnish may likewise be applied to copper, the polish of which it preserves and heightens in colour. It must prove of particular advantage to preserve philosophical instruments from any alteration in experiments in which they are exposed to water, and consequently rendered liable to rust.

Solar Spectrum.

From some experiments made by M. Ritter, of Jena, on the visible rays of the Solar Spectrum, he concludes, that there exist, without the spectrum, and at its two extremities, invisible rays, which possess the property of assisting oxygenation and disoxygenation. He has also observed a singular coincidence between these effects and those of Galvanism; for the eye, when placed in contact with the negative conductor of the pile, sees every object *red*, but if placed against the positive conductor, it sees them *blue*; whence there appears to result an analogy between the action of the negative electricity and that of red light, and of the positive and the violet light.

Aërostation.

Mr. Robertson, about the middle of July, ascended in a balloon from Hamburgh, accompanied by Mr. Lhoest. They ascended to the height of 2,600 toises, when the cold became so intense as to compel them to descend, which they did near Winsen on the Lake; but the inhabitants, taking them for spectres, fled with the utmost consternation, carrying with them their cattle, &c.; and the aëronauts, fearful of being fired at, were obliged to reascend, and continued their voyage to Winchtenbeck, near Zell, having traversed over a space of twenty-five French leagues in five hours.

Mr. Robertson's aërial excursion was undertaken for scientific purposes, and he has lately published the following

lowing account (being the second) of his journey and experiments.

"When the balloon rose, says he, the barometer was at twenty-eight inches. At eleven o'clock the machine, which had not been entirely filled, became so dilated that the inflammable air issued with a loud noise from the lower tube. As this aperture was not sufficient, I was obliged to open the upper valve. It remained open nearly a quarter of an hour, during which the balloon ascended in a perpendicular direction: at intervals we threw out some ballast. The atmosphere below us was serene, but above us it was somewhat cloudy.

"Although we approached the sun, the heat decreased as we ascended, and we could look at that luminary without being dazzled. When the barometer was at 14 inches, it appeared to become stationary. The thermometer was at 4½ degrees below Zero; the cold was not excessive, but the singing in my ears ceased, and all our faculties seemed to be palsied by a general indisposition. Having taken some wine to recruit our strength, we threw out some ballast, the mercury in the barometer fell to 12¼ inches. At that height the cold out of the car was insupportable, although the thermometer was only one degree below the freezing point. We were obliged to respire faster, and our pulse beat with extreme rapidity. We could scarcely resist the strong inclination to sleep with which we were seized. The blood rushed to our heads, and Mr. Lhoest remarked that it had entered my eyes; my head was so swelled I could not put on my hat."

In this region, where the balloon was invisible from the earth, Mr. Robertson made the following experiments.

1. Having let a drop of ether fall on a piece of glass, it evaporated in four seconds.

2. He

2. He electrified by friction glass and sealing wax. These substances gave no signs of electricity which could be communicated to other bodies. The voltaic pile, which, when the balloon was set free from the earth, acted with its full force, gave only a tenth part of its electricity.

3. The dipping needle seemed to have lost its magnetic virtue, and could not be brought to that direction which it had at the surface of the earth.

4. He struck with a hammer oxygenated muriate of potash. The explosion occasioned a sharp noise, which, though not very strong, was insufferable to the ear. It is also to be observed, that though the aëronauts spoke very loud, they could with great difficulty hear each other.

5. At that height Mr. Robertson was not able to extract any electricity from the atmospheric electrometer and condensor.

6. In consequence of a suggestion from Professor Hermbstadt, of Berlin, Mr. Robertson carried with him two birds; the rarefaction of the air killed one of them; the other was not able to fly; it lay extended on its back, but fluttered with its wings.

7. Water began to boil by means of a moderate degree of heat maintained with quicklime.

8. According to observations made, it appears that the clouds never rise above 2000 toises; and it was only in ascending and descending through clouds that Mr. Robertson was able to obtain positive electricity.

Artificial Yeast.

The following is the method employed in Germany and Sweden for making artificial yeast. To one hundred pounds of the best malt, consisting of one part of malted wheat

wheat and two parts of malted barley, dried in the open air, and well ground and bruised, add ten pounds of good hops, and brew the mixture with 350 pounds of water, to form wort. After a short boiling separate the grains and hops from the wort; which last, by continued boiling, may be reduced to 175 lbs. Cool it down as soon as possible to 70 degrees of Fahrenheit, and then mix it with 32 lbs. of yeast; the first time may be of common brewers yeast, but in every subsequent operation of the artificial. The wort will soon ferment, and in a few hours it will be covered with a thick yeasty froth; the whole mass must then be strongly agitated, and at the same time well mixed with from 50 to 75 lbs. of fine ground meal, of wheat or barley, malted or unmalted. In a cool place this yeast will keep ten or fifteen days in summer, and four or five weeks in winter. It is said to be as good as the best common yeast for the use of brewers, distillers, bakers, and pastry-cooks *.

Electricity.

Vassali Eandi has shewn, by repeated experiments, that metals and their oxides thrown on his electrometer bring thither a contrary kind of electricity; the metal, positive electricity; and the oxide, negative: and farther, that the electric fluid does not affect the fluid of the voltaic pile; the action of which is not altered by the union of positive electricity, to the negative pile, nor by another combination of electric and Galvanic conductors.

* The specification of a patent, granted to a Mr. Storck, for the same object, was published in the last number of this work.

Phosphate

Phosphate of Soda.

A German apothecary, named Funcke, has discovered a new method of preparing phosphate of soda, which he asserts to be more economical, expeditious, and easy, than any of the processes hitherto used by manufacturers and chemists *. His method consists in saturating the excess of lime contained in calcined bones with dilute sulphuric acid, and then dissolving the remaining posphate of lime in nitric acid. To this solution he adds a like quantity of sulphate of soda, and then recovers the nitric acid by distillation. The phosphate of soda is then separated from the sulphate of lime by the effusion of water and crystallization in the usual manner. A sulphate of soda is produced by mixing into paste, with a sufficient quantity of water, eight parts of burnt gypsum or sulphate of lime, five of clay, and five of common salt. This mixture is burned in a kiln or oven, and then ground to powder; the powder is put into water, which, after being strained and evaporated, is suffered to crystallize.

Potash.

From the experiments of M. Vauquelin, it results that the ashes of buck-wheat are very rich in potash, and may be employed with advantage in the glass-houses. The ashes of other vegetables contain only 18 to 20 *per cent.* of that alkali; those of buck-wheat contain 33, or nearly one-third.

* We apprehend this gentleman is mistaken, and that the method practised in England is more simple and advantageous than the process he describes.

List

List of Patents for Inventions, &c.

(Continued from Page 320.)

LAVER OLIVER, of Bury St. Edmunds, Suffolk, Upholder and Cabinet-maker; for dining, card, Pembroke, and other tables, upon an improved construction. Dated August 3, 1803.

JAMES HALL, of Mellor, in the parish of Glossop, Derbyshire, Weaver; for an improvement to the loom, whereby a new and cheap method of perpetually taking away the articles woven therein as they are woven is effected. Dated August 3, 1803.

FRANCIS GODBOLD, of Craven-street, Westminster, Dice-maker; for new-invented dice. Dated August 3, 1803.

BRYAN DONKIN, of Dartford, Kent, Mill-wright; for a mode of producing a rotatory motion applicable to useful purposes. Dated August 3, 1803.

JOHN EDWARDS, of Vine-street, Lambeth, Surrey, Engineer; for improvements in distilling, rectifying, and dying, whereby the same will be considerably accelerated, and the consumption of fuel will be materially reduced. Dated August 3, 1803.

MICHAEL LOGAN, of Paradise-street, in the parish of St. Mary, Rotherhithe, Surrey, Engineer; for a conservative lock, for the use of inland or canal navigation. Dated August 5, 1803.

CATHCART DEMPSTER, of St. Andrew's, North Britain, Gentleman; for improvements in the manufacture of canvas or strong cloths, of vegetable materials, for sails, tents, packages, and other useful purposes. Dated August 30, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XVIII. SECOND SERIES. Nov. 1, 1803.

Specification of the Patent granted to LAWRENCE HOLLISTER, *of Norfolk-street, in the Parish of St. Mary-le-bone, in the County of Middlesex, Artist; for certain Machinery for improving Roads.*

Dated May 5, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Lawrence Hollister, in compliance with the proviso in the said letters patent granted unto me for certain machinery, for the purpose of cleansing and repairing roads, do hereby declare the meaning and intention of my invention in manner and form following; that is to say: My said invention consists of two or more wheels, double tyred, on an iron axletree or axletrees, on which I place springs, supporting a large board, which I call a bed or bottom, to which

I fasten my machinery, which has an angular piece of iron, see L, Fig. 2, Plate XVII. (the lower part of which represents the edge of a knife,) with three uprights in the same form, working through the bed in spring sockets, by means of a rack, which rack hath holes to put pins in the socket, as also three other sockets in the same manner, to which I attach two curved or semi-circular irons, which I call rutlers, the bottoms of which are formed as the angular one, into which, by the motion of the machine, the dirt, gravel, or earth, is collected from the sides of each rut or furrow made by the wheels of carriages, and returned through an open part in each rutler into the ruts or furrows, so continuing the gravel on the road. These irons I secure by a cross bar, and each or all are raised higher or let lower as found necessary, by means of pinions in cocks F, in Fig. 1, fastened to the bed by screws, and by the use of the racks aforesaid. Behind those rutlers, is a board, which I call a tail-board, secured to the bed, to which a harrow is fixed, to level new-made gravel, and may be used or disused at pleasure. From the outside of each rutler (they taking the ruts or furrows made by the wheels of carriages) as also from the front point of the angular iron to take the middle of the road, I fasten chains or ropes, holes being made for that purpose, and hook to the front of the bed, or to the shafts, or other parts of the machine, as preventors, when the roads are so heavy as to endanger the works. At the extreme ends of the tail-board, or to the bed, or other parts of the machine, is fastened a roller or rollers, to take the road so levelled as before described by the rutlers, &c. to press and roll it, occasioning the wet to rise and run off it, thereby making it more firm without scraping it, consequently will

will require much less gravel than by the present method of scraping roads. See the drawings and explanation hereunto annexed, whereby the same are more particularly described. Other modes I have adopted to produce the same effect; as, for instance, the fixing the bed or bottom so as to be drawn on three or four wheels, and an iron stay may be fixed from the tail-board or hind end of the bed or bottom to act as a pressure on the harrows, should an extra weight be required to any large quantity of gravel.

And farther, in addition to the aforesaid semi-circular rutlers may be added two scrapers, of a like form as scrapers, which may be raised up or let down at discretion, and which will gather up all the dirt, gravel, &c. that may escape the rutlers. Over the roller or rollers is suspended a scraper K, to keep them from dirt, &c. which may adhere thereto. To secure the works from injury by weather, a box, the size of a bed, is put on the top thereof, divided into partitions and folding covers; in the front part will be put stones or other weight, when required, the better to balance the machine.

In witness whereof, &c.

EXPLANATION of PLATE XVII.

Fig. 1, A, the wheels. B, the shafts. C, the bed or bottom. D, the cocks which receive the pin or bolt through the rack that prevents the rutlers from dropping down after being raised to the height required. E, the sockets through which the uprights pass. F, the pinions which, by means of the handle, as *per* Fig. 6, raises the rutlers either separate or together. G, the tail-board, about three inches thick, one foot and half deep, fastened to the bed or bottom edgewise close to the back of the

 rutlers.

rutlers. N. B. The tail-board the same breadth as the bottom. H, the harrow, fastened to the tail-board with joints, and may be raised up and secured by a chain, or lowered down to level the gravel at discretion. I, the roller fastened to the extreme ends of the tail-board, which serves to level and press the road. K, the scraper, to scrape off the dirt that may adhere thereto.

Fig. 2, L, the angle or foot rutler, which follows the horse-track, and gathers up the dirt, and conveys it into the semi-circular rutlers through which it passes into the wheel-ruts or furrows. M, the semi-circular rutlers which follow the wheels, and gather up the dirt raised up by them, which it forces through the open part into the ruts or furrows. N and O, the uprights and racks which enter the sockets. P, the chains in the rutlers to fasten to the front of the bed or bottom, or any other part most convenient.

Fig. 3, the angle or foot-rutler. A, the holes that receive the stirts and screws belonging to the springs.

Fig. 4, the right and left rutlers, which join to the angle or foot-rutler by means of springs, Fig. 5, with stirts set at the back, and one or more screws, with nuts on the points of the screws to secure them. B, the channel through which the stirts and screws pass into the holes.

Specification

Fig. 4

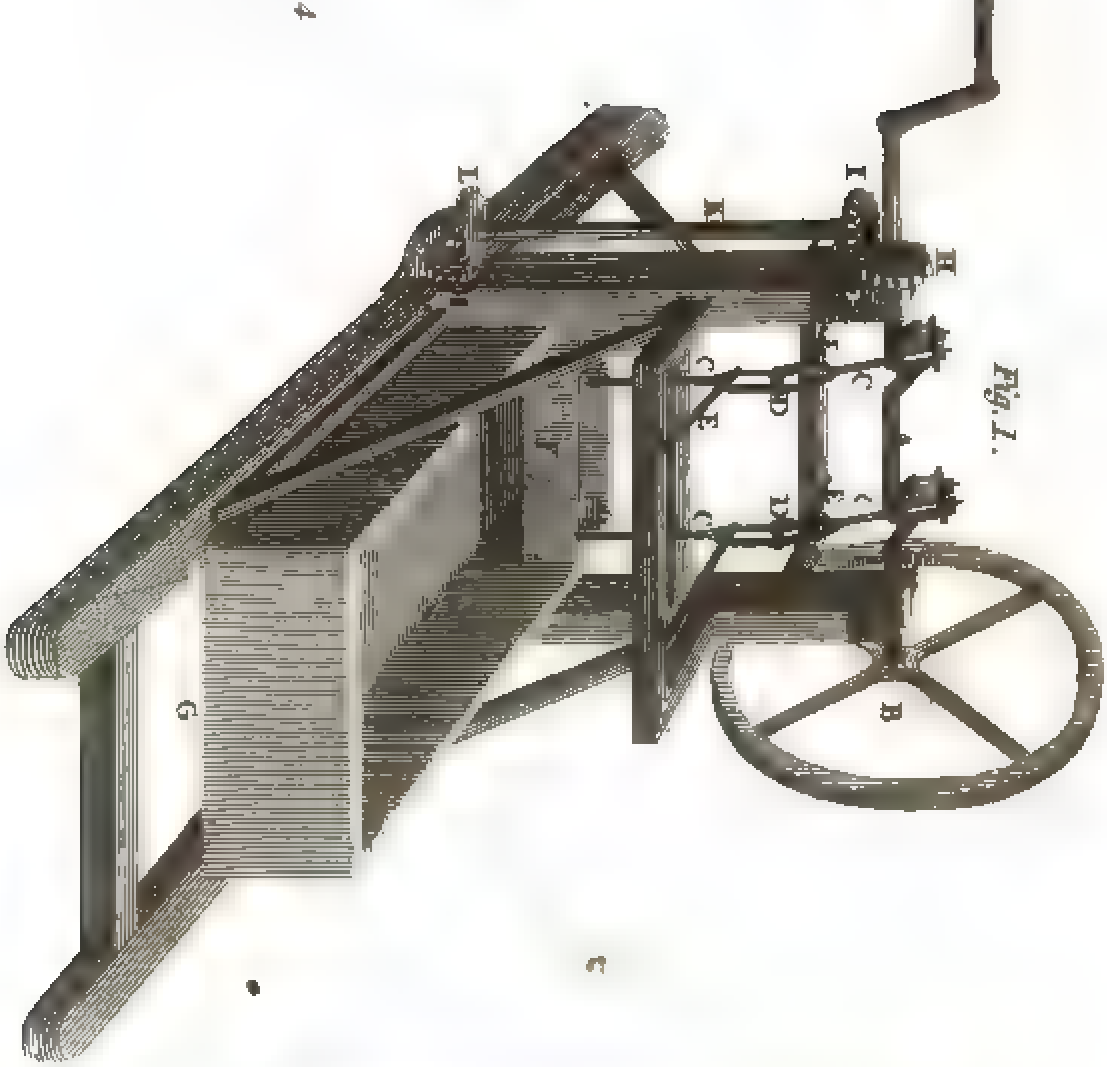


Fig. 1.

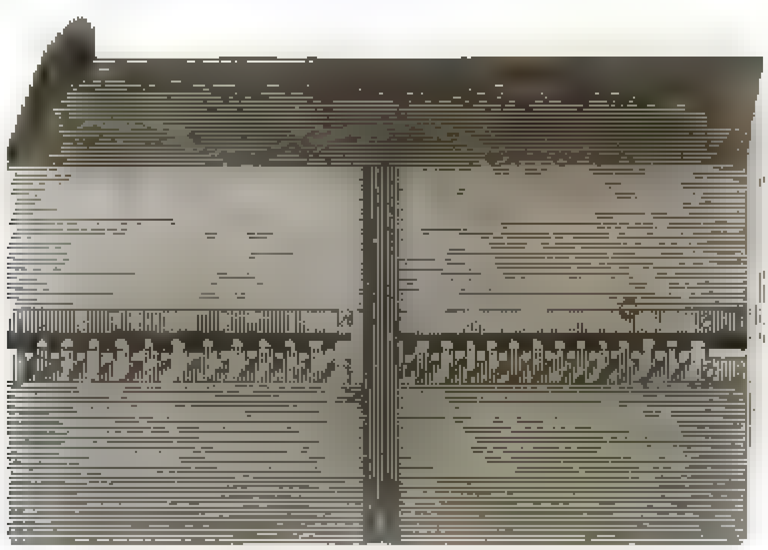


Fig. 2.

Fig. 3.

Specification of the Patent granted to THOMAS BROWN, *of Alnwick, in the County of Northumberland, Whitesmith; for a Machine for cutting or shreding Tallow, cutting Turnips, Carrots, Potatoes, or other Fodder for feeding Cattle, for cutting Tobacco, kneading Dough, bruising Fruits, or any other Matter requiring the same.* Dated July 2, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Brown do hereby declare that the nature of my said invention of a new method of cutting turnips, potatoes, carrots, or any other fodder for feeding cattle, for cutting or shreding butchers fat, for the easier melting it into tallow, and by which means a great saving is made, as well in collecting a greater quantity of tallow (from a given quantity of fat), as in time, labour, and fuel, for the cutting tobacco, kneading dough, bruising fruits, or any other matter requiring the same, is particularly described and ascertained by the drawings hereunto annexed, in the following manner; that is to say;

A, Fig. 1, (Plate XVIII.) is a crank, to which is attached the fly-wheel B, and the working rods C, C, C, C, to the joints D, D; in these rods are attached parallel joints E, E, E, E. These prevent friction and noise, otherwise the machine may be made without them. To the lower part of the working rods C, is fixed the knife or bruiser F, which, by the motion of the crank, is raised or driven downwards with the necessary force required. G, is the trough or box (made to slide between the

the frame-work) into which the matter to be cut or bruised is to be put. H, is a bevelled cog-wheel, fixed on the crank A: this works I, another wheel, fixed horizontally on the upright-shaft or axle K, working on a bearer. At the lower end of this shaft is fixed another horizontal wheel L, working into the wheel M. These wheels are all bevelled, and of one size and number. This last-mentioned wheel is fixed on a horizontal shaft or axle, Fig. 3, working in the frame-work below the box. This shaft has a tooth N, Figs. 3 and 4. On the bottom of the box is fixed a rack O, Fig. 2, into which the tooth N works, and thus moves the box until one end thereof comes close to the knife, when it will go no farther, the tooth N not acting on the smooth pieces at each end of the rack O. On reversing the motion of the crank, it will be driven back again until the matter is sufficiently cut or bruised. The motion of the box may be accelerated or retarded at pleasure, by mechanical methods already well known. The machine may be driven by the hand, horse, steam, water, or any other power. If a circular box is preferred, it may be worked with circular racks, and on a pivot or centre.

In witness whereof, &c.

Observations by the Patentee.

First. It must be obvious that the cutting of turnips, carrots, cabbages, and such like food, will have many advantages in the feeding of cattle, and this method of doing it will be so easily performed, and at so small an expense, when a boy, or an old man, can cut as much food in an hour as will serve a good number of cattle a whole day; and the machine is so portable, that it may be

be used with equal ease and advantage in the field, the farm-yard, the hovel, or the barn.

Second. It will prevent cattle being choaked, as is often the case with whole turnips, &c.

Third. It will cause them to eat their food clean up, and prevent much waste, (even the tops or shaws may be cut with the roots,) whereas it often happens that when turnips, &c. are broke into by cattle in wet or frosty weather, they are thus left to rot upon the ground, without the cattle ever again touching them, and thereby much loss is sustained.

Fourth. In frosty weather turnips, &c. are so hard, that scarcely any beast can penetrate them, but particularly young cattle, when casting their teeth, so that they are nearly starved with hunger, and lose their flesh considerably; and the summer is often far advanced before they regain the weight and condition they lost in the winter and spring.

Fifth. In the cutting or shreding of tallow in the easy, expeditious, and regular manner, in which the machine does it, it is also obvious there must be a great saving of labour, time, tallow, and fuel. In cutting tallow by hand, which is laborious, slow, and imperfect, there are often lumps uncut, which, when put into the boiler, are so slow in melting, and sometimes never melt at all, that a great loss is sustained by the unmelted tallow, and also in the evaporation of the melted tallow, in waiting for the lumps melting; whereas, by being effectually cut, it melts regularly, expeditiously, in better condition, and is more productive. These facts have been clearly ascertained by all the tallow-chandlers who have tried the machine, to whom references might be given if required. A man may cut with ease ten stone in five minutes.

Sixth.

Sixth. With respect to tobacco, it will do its work with equal facility; and it is at a much lower price than many of those cumbrous machines which are in use for that purpose. Its utility in kneading dough, bruising fruit, &c. is equally obvious at first sight.

Specification of the Patent granted to THOMAS SAINT, *of the City of Bristol, Engineer; for a Method of increasing the Effect of Steam-Engines, and saving Fuel in the working thereof.* Dated December 21, 1802.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Thomas Saint do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are hereinafter particularly described and ascertained; that is to say: I make an opening of considerable magnitude in the bottom of the boiler, nearly as large as the flue, which would be suitable to the boiler made use of; in which opening I fix a pipe or tube, through which pipe or tube a communication takes place between that part of my furnace or fireplace, in which the flame or heated air rises or circulates, and the interior space of my boiler, in which steam is produced or maintained, for the supply of the engine, which pipe or tube may remain open. But I prefer to close the said opening by a valve or cock, or safety tube, so adjusted, counterpoised, or constructed, according to the well-known methods of engineers, chemists, and other operators, as that no part of the steam or heated air contained in the said interior space of the boiler shall be permitted

permitted to escape through the said opening, but that the flame or heated air from the furnace or fire-place shall or may enter, and be admitted through the said opening whenever and so often as the elastic force or re-action of the steam shall be less than any determinate or particular degree at which the adjustment, counterpoise, or construction of the said valve or cock, or safety tube, shall open, and allow a clear passage for the flame or heated air. And I do also construct and dispose the parts of my furnace or fire-place so as may best serve to cause the said flame or heated air to pass in due quantity through the said opening when unclosed, instead of being totally, or for the most part, driven up the chimnies, or in other less useful directions; that is to say, I place the lower entrance of the flue of my chimneys at a moderate distance higher than the grate which supports the fuel, and I fix a moveable shut or register therein; and I am particularly careful that the space above the fire, into which the flame or heated air do descend, shall be well closed on all sides, so that the side flame or heated air shall not be allowed to escape in any manner or direction except through the said opening, or through the flue of the chimney. And I do declare that the power and effect of engines worked by the steam from boilers, having a communication with the fire, according to my said invention, is greatly increased, so that a greater quantity of work may be performed with the same expense of fuel than could be performed by a like engine not supplied according to my said invention. Or in case the quantity of work required to be done by engines supplied with steam, or heated air, according to my said invention, be the same as is ordinarily done by like engines not supplied according to my said invention, then the quantity of fuel necessary to do the work according to

to my said invention, would be much less than would otherwise have been required to produce the same effect. And in order that the practical process, or means of carrying my said invention into full effect, may be perfectly known and understood, I proceed to describe the same as follows: first, I do (in preference) make my opening through the bottom of the boiler immediately over the fire-place, and I fix a tube or pipe round the said opening, and passing upwards through the body of water and water-wheel, need not be deeper on the crown of the boiler than six inches, so as to have its upper orifice in the clear space above the water at a sufficient height to prevent any part of the water from entering or passing through the same. Secondly, I fix a valve, opening upwards at the top of the said pipe or tube as large as the bore will permit. Thirdly, as the weight of the valve would prevent its rising, even when the strength of the steam was such as to suffer the flame or heated air to enter through the opening into the boiler, I fix a rod to the said valve, and pass the same through the top of the boiler, where I attach the same to a lever, with a counterpoise, which may be set at different distances on the lever, according to the force of descent which it may be found desirable to allow the valve to retain. Fourthly, in such cases or constructions in which there may be any reason to fear that the upper part of the pipe or tube, or circumference of the opening, should become so hot as to suffer injury, I conduct the feeding water of the boiler directly upon the crown of the valve, or into a small bordering cavity or trough round the inner edge of the pipe or tube or opening, by which means the temperature of the heat cannot exceed that of boiling water. And, in general, I declare that the flame or heated air can and may be introduced into the boiler by various other

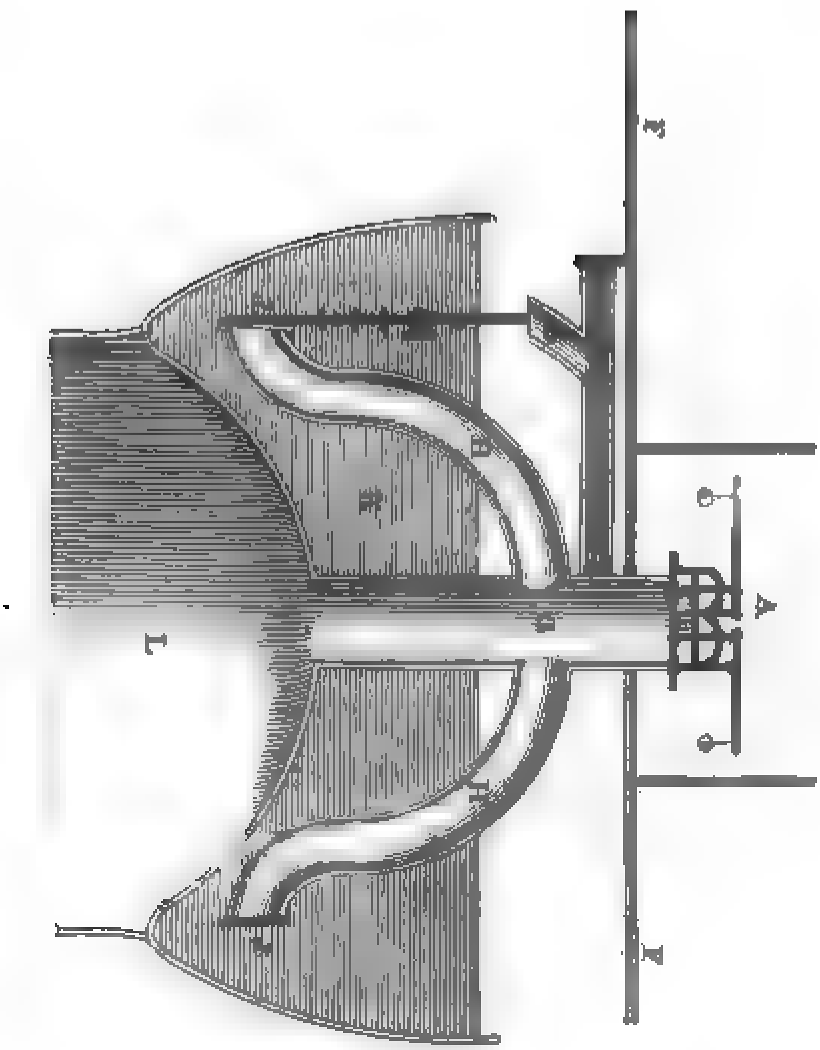


Fig. 1.

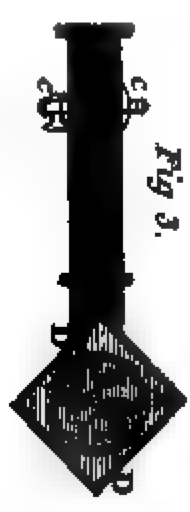


Fig. 3.

Fig. 2.

other methods or modifications. But what I claim as my invention is, that the furnace or fire-place in which the flame or heated air rises or circulates shall have an open or regulated communication with the interior space of the boiler, or other apparatus wherein steam is produced, so that a combination of the flame or heated air, and the steam generated, may pass from the boiler to the cylinders of fire-engines.

In witness whereof, &c.

Specification of the Patent granted to RICHARD HARE, *of Limehouse, in the County of Middlesex, Brewer; for an Apparatus whereby the essential Oil of Hops (which he is informed is the most efficacious and preservative Part of that Vegetable, and which, till this Invention, was lost and dissipated in the Air during the Operation of boiling Worts for Beer) is preserved and applied to use; and that, by Means of the said Apparatus, his Water for brewing is heating to such a Degree of Heat as he judges necessary, and as he believes is customary, and that his said Water is heated in less than the usual Time for boiling Worts for Beer, and that without any Application of Fire to the Vessel containing the said Water.* Dated September 12, 1791 *.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Richard Hare, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and the man-

* See an account of a trial concerning the validity of this patent, page 232 of this volume, in which the same principles were held to be exemplified in the following specification of Mr. Wood.

ner in which the same is to be performed, as follows; that is to say:

A, Fig. 1, (Plate XIX.) the trunk, which incloses the valves. B, the rising valve and frame. C, the sinking valve (see Fig. 3.) D, the lever, with its weights to shift occasionally. E, the valve plate, Figs. 1 and 3, on which the valve frames are fixed; the valves also are made in it. F, the bottom of liquor-back. G, a large cylinder connected and communicated with the main copper. H, H, two doubled curved branch pipes connected with the cylinder G, and opening into the jack-back near its bottom by the valves at *d*, *d*, occasionally. I, the straight branch pipe communicating with the cylinder G, with a curve returned at *b*, from the under side, in which is inserted the three pipes *c*, *d*, *e*, with their cocks and screws, (see Fig. 3). K, jack-back or boiling-back. L, the boiler and man-hole. The upright pipe or cylinder G is open into the copper, into which pipe the steam rises when the copper begins to boil. It is stopt at the top by the valves B and C; it has free communication into the pipes H, H, where it may pass into the liquor in the jack-back, or not, as thought proper. It has also a free communication into the straight branch pipe I, with its three branches Fig. 2. These three branches have cap screws at their ends, and cocks so fixed as to be opened when they are wanted, The valves B and C are reverse, one opens downward and one opens upward, with adjusting weights and levers, (Fig. 1 and Fig. 3). The one that rises upwards prevents any overstrain happening to the boiler, and entirely secures it from inward strains. The valve that opens downwards admits the atmosphere to pass into the boiler in case it is emptied or cooled too hastily, and perfectly secures the boiler from any accident happening that way. In witness whereof, &c.

Specification of the Patent granted to Sutton Thomas Wood, *of the City of Oxford, Brewer; for certain new Discoveries in the Application of Steam, and also certain Methods of using the Water produced from condensed Steam, and for applying the Water from the Coppers or Boilers of Steam-Engines to other Purposes than that of working the Steam-Engine; and also various Methods of heating and applying Water for the several Purposes of the Breweries and Distilleries, and for forwarding the Process of Brewing; and also certain Methods of constructing and adapting Coppers, Boilers, Tubes, and other hollow Bodies, for the more effectual Means of heating Water and Worts, and of rendering such Coppers, Boilers, Tubes, and other hollow Bodies as are employed in the Breweries and Distilleries Steam and Air tight.*

Dated November 17, 1784. — Term expired.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Sutton Thomas Wood do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is hereinafter particularly described and ascertained; that is to say:

My first application of steam is, the application of that steam which arises from the water, liquor, worts, or other solutions which are or may be heated or boiled in all or any of such coppers, pans, kettles, or boilers, as are used and employed in breweries, distilleries, the various manufactures of sugar, soap, salt, and allum, and all other trades and manufactures whatever, to those engines commonly called or known by the name of steam or fire engines, so that the same steam which arises either during the process of the trade or manufacture, or from water or liquor heated or boiled for the purposes of the same,

same, may be rendered capable of working the steam-engine; and this I do by covering over the top of the copper, pan, or boiler, with copper, iron, brass, or any other materials, and by means of pipes, tubes, funnels, or other hollow bodies, or by any other means, forming a communication with the steam-engine; to which copper, pan, or boiler, I apply safety valves and doors, either upon the same principle as those which are generally applied to the boilers of steam-engines, or upon any other principle. But I have various ways of adapting and connecting coppers or boilers used in trades and manufactures to the steam or fire engine, in order that the steam arising therefrom may be applied upon the above-mentioned principle, and rendered capable of working the same. Many of which methods I have particularly specified and described in a specification, duly inrolled agreeably to and by virtue of certain letters patent, granted to me the said Sutton Thomas Wood, by his present Majesty king George the Third, bearing date the twentieth day of August, in the year of our Lord one thousand seven hundred and eighty-four, "for certain new improvements on the steam-engine, and other things therein contained *," as in and by the said specification (relation being thereunto had) may more fully and at large appear. But let it be here observed, that it is not of any consequence in what shape, form, or method, the coppers, pans, or boilers may be constructed or adapted, provided they are constructed or adapted upon the above-mentioned principle; namely, that the same steam which arises from the water, liquor, worts, or solutions, heated or boiled therein, may be rendered capable of working the steam-engine, nor is it of any signification from what copper, pan, or boiler, the steam may arise,

* This specification is deposited in the Rolls Chapel. It is extremely voluminous, and contains little that would be interesting at this day.

which

which is applied to the working of the steam-engine, provided it arises from any copper, pan, or boiler, which is either employed in the carrying on, or in any wise applied to the use of any business, trade, or manufacture whatever. Nothing, however, above mentioned is meant to extend to those coppers or boilers which are solely appropriated to, and applied to no other purpose than the working of the steam or fire engine.

My second application of steam is, the application of steam to the making and preparing of sugar, salt, and allum, which I do by placing one pan or vessel over another, and by fastening and connecting them together either by means of doors or shutters, or by means of pipes, tubes, or funnels, or by any other means so as to cause the steam which arises from the lower pan or vessel to heat the sugar, salt, or allum, in the upper pan or vessel, and make or prepare the same. But, in order to hinder any particles of the condensed steam from falling back into the lower pan or vessel, and checking the evaporation, I sometimes make the top of the lower vessel, which may likewise serve for the bottom of the upper vessel, somewhat convex, spherical, or inclined, so as to cause the drops as they generate to roll down the same into grooves, furrows, or channels, which are made to surround the sides of the lower vessel, and to be conveyed away by means of holes or apertures, or cocks or valves placed therein for that purpose. But I have various ways of constructing pans and vessels upon the above principle, which, together with the nature of the grooves, furrows, or channels, and the valves and doors that may be applied upon this occasion, I have more particularly mentioned in the specification above referred to, wherein I describe my method of adapting and connecting those coppers, pans, or boilers, used in trades or manufactures, to the steam or fire engine, where the

the nature of the trade or manufacture requires a quick evaporation.

My third application of steam is, the application of steam to the heating of stoves, either such stoves as are used for the drying of sugar or salt, or any other stoves, or to the heating of all or any such places and things as are in general heated by fire, or by any other means, and to heat which steam may be used or applied, which I do by means of tubes, pipes, funnels, or other hollow bodies, made in such forms and shapes, and thrown in such directions, as may be most suitable to the particular places and purposes for which they may be required.

My fourth application of steam is, the application of steam to the heating of water, or any liquor for the purposes of trades or manufactures; and this I do either by causing water, liquors, worts, or other solutions, to be placed in vessels or other hollow bodies, which are made to surround or to be in contact with the copper, boiler, or vessel, in which water or liquor are heated or boiled so as that the steam arising from such copper or boiler may heat the same, or by conveying the steam by means of pipes, tubes, or other hollow bodies, to the sides, top, bottom, or any other part of the vessel or hollow body in which the water or liquor is or may be contained, or by conveying the steam through the water or liquor by means of pipes or tubes as aforesaid, or by any other means, so as that the water or liquor required to be heated may be heated by steam.

My fifth application of steam is, that of condensing such steam as arises from the coppers, pans, or boilers, used in trades and manufactures, which I do not only with, but also without, the power of the steam or fire engine, either by means of cold water or other liquor, or by causing the steam to flow through cold pipes, funnels, or hollow bodies, or to come in contact with cold bodies,

or

or by any other means; and of applying the hot water produced by such condensed steam to the various purposes of trades and manufactures. Let it be remembered also, that I apply the hot water which is produced by such steam as is or may be condensed by the power of the steam-engine to the like purposes of trades and manufactures.

My sixth application of steam is, the application of that steam which arises from sugars, unfermented worts, and all other unfermented solutions, which I do not only apply to any of the purposes above mentioned, and condense the same, and use the liquor produced by such condensed steam, but I also cause such liquor as is or may be produced by the condensed steam of sugar, unfermented worts, and other unfermented solutions, to be put into a state of fermentation, and to pass through the process of distillation. And the liquor produced thereby I use either for the purposes of trades or manufactures, or for any other purpose to which it may be applied.

My first improvement in the constructing and adapting of coppers or boilers consists of the following principle, namely; in causing that heat which is generally absorbed and lost in the sides, back, and other parts of such fires or furnaces as are used in trades and manufactures, to be applied to the heating or boiling of water or liquor in other coppers or vessels than those which are generally used for the purposes of trades or manufactures; so that a greater quantity of water or liquor may be heated and boiled either for the purposes of the trade or manufacture, or for any other purpose; and the process of the trade or manufacture may be thereby greatly forwarded without any extra consumption of fuel. And this I do by adapting, connecting, or applying, coppers, boilers, or vessels, near to, or in contact with, such fires or furnaces, either on the sides or back, or any part of the

the same, so as that the water or liquor contained in such coppers or vessels may be heated or boiled thereby. Which method of constructing and adapting coppers or boilers I have more particularly described in the specification above mentioned and referred to; wherein I have explained my method of working the steam or fire engine by means of such separate and detached coppers or boilers as are constructed and adapted upon the above-mentioned principle.

My second improvement is the adapting and connecting coppers, boilers, or vessels, constructed upon the above-mentioned principle to the steam or fire engine; so that the same fire necessarily used for the purposes of trades and manufactures may at the same time be applied to the use of the steam or fire engine.

My third improvement is in causing the heat of the fire to be conveyed through the water or liquor, either by means of tubes, flues, or other hollow bodies, or by causing the fire or furnace to be in the middle, or in any other part within the body of the liquor, either in the form of a cone or pyramid, or in any other form, and the water or liquor to surround the same; nor is it of any consequence in what form or shape the copper or boiler is made or constructed, or in what direction the pipes or tubes are placed, provided it is constructed upon the above principle of causing the fire or heat to be conveyed through the body of the water or liquor contained therein instead of conveying the heat or fire entirely through the water or liquor in the copper, boiler, or vessel. I sometimes cause the bottom of the copper or boiler to be made in the shape of a cone or pyramid, so as to cause a greater surface to be exposed to the heat of the fire, and the heating or boiling of the liquor contained therein to be forwarded thereby.

In witness whereof, &c.

Observations

Observations on the Quantity of horizontal Refraction; with a Method of measuring the Dip at Sea.

By WILLIAM HYDE WOLLASTON, *M. D. F. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

IN a paper which I some time since presented to this Society, (printed in the Phil. Trans. for 1800,) I endeavoured to ascertain the causes, and to explain the various cases, of horizontal refraction, which I had either observed myself, or had seen described by others.

At the time of writing that essay, I had not met with the "Mémoires sur l'Egypte," published but a short time before; and I was not aware that an account had been given by M. Monge, of the phenomenon known to the French by the name of *mirage*, which their army had daily opportunities of seeing, in their march through the deserts of Egypt.

In the perusal of this memoir, I could not fail to derive instruction from the information it contained; but, as the facts related by him accord entirely with the theory that I had advanced, I was by no means induced to adopt the explanation that he has proposed, in preference to my own.

The definite reflecting surface which he supposes to take place between two strata of air of different density, is by no means consistent with that continued ascent of rarefied air, which he himself admits; and the explanation founded on this hypothesis will not apply to other cases, which may all be satisfactorily accounted for, upon the supposition of a gradual change of density, and successive curvature of the rays of light by refraction.

I have since learned that the same subject had also been ably treated by Mr. Woltman, in Gilbert's "Annalen der Physik;" but I have to regret that this dissertation, as well as that of Grüber, in the same Annals, were written in a language that was unknown to me, and that I could not avail myself of the assistance that I might otherwise have received from their researches.

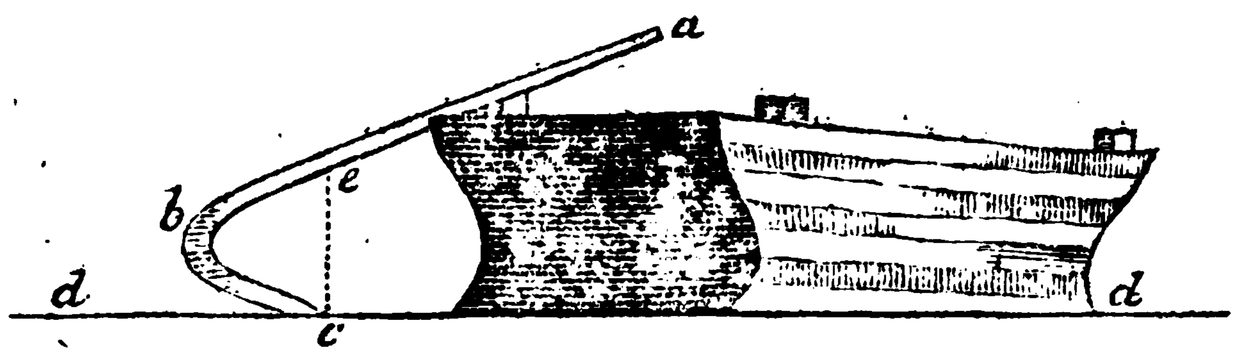
When I formerly engaged in this inquiry, being impressed with the advantage to be derived from it to nautical astronomy, on account of the variations in the dip of the apparent horizon, from which all observations of altitude at sea must necessarily be taken, I suggested the expediency of a series of observations, to be made by a person attentive to those changes of temperature or moisture of the atmosphere, on which he might find the depression of his horizon principally to depend. I had at that time no expectation that I could myself pursue this subject farther to any useful purpose, having little prospect of residing for a sufficient length of time in view of the sea, and seeing no other method by which the same end might be accomplished. I have, however, since that time, found means to satisfy myself, by observations over the surface of the Thames, that although the quantity of refraction varies in general with any change of the thermometer or hygrometer, yet the law of these variations is not altogether so simple as I had hoped it might be found.

I shall, on the present occasion, first relate the facts on which this opinion is founded, and which are in themselves sufficiently remarkable, on account of the unexpected quantity of refraction observable over a short extent of water; I shall, in the next place, shew that the exact determination of the concurrent changes of the atmosphere are of less value, and their irregularities of

less

less consequence, than I had conceived, as there is a very easy method whereby the quantity of dip at sea may be at any time correctly measured; and therefore the end which I sought by indirect means, may be at once directly attained.

The first instance that occurred to me, of observable refraction over the surface of the Thames, was wholly accidental. I was sitting in a boat near Chelsea, in such a position that my eye was elevated about half a yard from the surface of the water, and had a view over its surface, that probably somewhat exceeded a mile in length, when I remarked that the oars of several barges at a distance, that were then coming up with the tide, appeared bent in various degrees, according to their distance from me. The most distant appeared nearly in the



form here represented; *d d*, being my visible horizon by apparent curvature of the water; *a b*, the oar itself in its inclined position; and *b c* an inverted image of the portion *b e*. By a little attention to other boats, and to buildings on shore, I could discern that the appearance of all distant objects seen near the surface of the water was affected in a similar manner, but that scarcely any of them afforded images so perfectly distinct as the oblique line of an oar dipped in the water.

A person present at the time (as well as some others to whom I have since related the circumstance) was inclined to attribute the appearance to reflection from the surface of the water; but, by a moderate share of attention, a very

very evident difference may be discovered between the inversion occasioned by reflection, and that which is caused by atmospherical refraction. In cases of reflection, the angles between the object and image are sharp, the line of contact between them straight and well defined, but the lower part of the image indefinite and confused, by means of any slight undulation of the water. But, when the images are caused by refraction, the confines of the object and its inverted image are rounded and indistinct, and the lower edge of the image is terminated by a straight line at the surface of the water. In addition to these marks of difference, there is another circumstance which, if attended to, must at once remove all doubt; for, by bringing the line of sight near to the surface of the water, boats and other small objects are found to be completely hidden by an apparent horizon, which, in so short a distance, cannot be owing to any real curvature of the water, and can arise solely from the bending of the rays by refraction.

When I reflected upon the causes which were probably instrumental in the production of these phenomena, they appeared referrible to difference of temperature alone. After a succession of weather so hot that the thermometer, during one month preceding, had been twelve times above 80°, and on an average of the month at 68°, the evening of that day (August 22, 1800) was unusually cold, the thermometer being 55°. The water might be supposed to retain the temperature it had acquired during a few weeks preceding, and, by warming the stratum of air immediately contiguous to it, might cause a diminution of its refractive density, sufficient to effect this inverted curvature of the rays of light, in the manner formerly explained. As I was at that time unprovided with instruments of any kind, I had it not in my power to esti-

mate

mate the quantity of refraction, or temperatures; and can only say that, to my hand, the water felt in an uncommon degree warmer than the air.

Being thus furnished with an unexpected field for observation, I from that time took such opportunities as similar changes of the weather afforded me, of examining and measuring the quantities of refraction that might be discovered by the same means over another part of the river, that I found most suited to my convenience.

The situation from which the greater part of my observations were made was at the SE corner of Somerset-house. The view from this spot extends under Black-friars-bridge, towards London-bridge, upwards of a mile in length, and in the opposite direction through Westminster-bridge, which is three quarters of a mile distant.

Such distances are however by no means necessary; and indeed the air over the river, in cold weather, is generally, or at least very frequently, not sufficiently clear for seeing distinctly to so great distances. For, since the winds which are most likely to effect a sufficient change of temperature, on account of their coldness, are usually from the E, or NE, the principal smoke of the town is then brought in that direction, and hovers, like a dense fog over the course of the river. This circumstance deprived me of many opportunities which the changes of the thermometer indicated to be favourable for my purpose, and obliged me often to make use of shorter distances than I should otherwise have chosen, by bringing the line of sight as near as I could to the surface of the water.

For this purpose, I had a plane reflector fitted to the object-end of a small pocket telescope, at an angle of 45°, so that, when the telescope was held vertically, it gave a horizontal view at any level that was found most eligible.

When

When the water has been calm, I have observed that the greatest refraction was visible within an inch or two of its surface, and I have then seen a refraction of six or seven minutes in the space of 300 or 400 yards: at other times, I have found it greatest at the height of a foot or two; but, in this case, a far more extensive view becomes necessary.

The first measures that I took were on the 23d of September, 1800. The water was 2½° warmer than the air, and I found a refraction of about 4′.

Oct. 17. The difference of temperature was 3°, and the refraction 3′.

Oct. 22. The water was 11¼° warmer than the air, yet the quantity of refraction did not exceed 3′.

The smallness of the quantity of refraction upon this occasion I attributed to the dryness of the atmosphere, conjecturing that a rapid evaporation might in great measure counteract that warmth which the water would otherwise have communicated to the air.

From that time, therefore, I have noted not only the heights of the thermometer in the water and in the air, but have added also the degrees of cold produced by keeping the bulb of it moistened for a sufficient time to render it stationary. In confirmation of my conjecture respecting the dryness of October 22, I have also, in the following table, which comprises the whole of my observations, inserted a column from the Register kept at the apartments of the Royal Society, containing the heights of the hygrometer, on those mornings when my observations were made.

TABLE.

TABLE.

At 8, A. M.	Air.	Water.	Differ-ence.	Refrac-tion.	Cold by Evapo-tion.	Hygro-meter.
1800. Sept. 23	57	$60\frac{1}{2}$°	$3\frac{1}{2}$°	4′	- -	72°
Oct. 17	$46\frac{1}{2}$	$49\frac{1}{2}$	3	3	- -	72
22	38	$49\frac{1}{2}$	$11\frac{1}{2}$	3	- -	67
Nov. 1	41	$45\frac{1}{2}$	$4\frac{1}{2}$	8	$\frac{1}{2}$°	76
4	$43\frac{3}{4}$	$46\frac{3}{4}$	3	3—	$1\frac{3}{4}$	72
5	37	45	8	3+	1	69
12	$44\frac{1}{2}$	48	4	1+	$3\frac{1}{2}$	73
13	40	$44\frac{1}{2}$	$4\frac{1}{2}$	5	$\frac{1}{2}$	76
1801. June 13	50	63	13	9+	5	65
22	55	61	6	6+	6	65
23	55	62	7	6	$4\frac{1}{2}$	65
24	55	61	6	5	3	67
Sept. 8	60	64	4	7	2	78
9	64	$64\frac{3}{4}$	$\frac{3}{4}$	5	3	74
10	58	64	6	7	2	70
12 o'clock, 10	63	64	1	2		

From a review of the preceding table it will be found, upon the whole, that when the water is warmer than the air, some increase of depression of the horizon may be expected; but that its quantity will be greatly influenced and in general diminished, by dryness of the atmosphere. It appears, however, that no observable regularity is deducible from the measures above given; but that the quantity, on some occasions, is far different from what the states of the thermometer and hygrometer would indicate. On the 9th of September, for instance, the difference of temperature is only $\frac{3}{4}$°, and the evaporation, to counteract this slight excess of warmth, produced as much as 3° of cold; nevertheless, the refraction visible was full 5′. In this observation I think that I could not be mistaken, as the water was at the time perfectly calm,

 the

the air uncommonly clear, and I had leisure to pay particular attention to so unforeseen an occurrence.

This one instance appears conformable to the opinion entertained by Mr. Huddart, and by M. Monge, that, under some circumstances, the solution of water in the atmosphere causes a decrease in its refractive power; but on no other occasion have I been induced to draw a similar inference.

The object that I have at all times chosen, as shewing best the quantity of refraction, has been either an oar dipped in the water at the greatest discernible distance, or some other line equally inclined; and the angle measured has been, from the point where the inverted image is terminated by the water, to that part of the oar itself which appears to be directly above it. (The apparent magnitude of *e c*, Fig. p. 421.)

The eight first angles were taken with a mother-of-pearl micrometer in the principal focus of my telescope, and are not so much to be depended upon for accuracy as the succeeding eight. These last were measured with a divided eye-glass micrometer, and consequently are not liable to any error from unsteadiness of the instrument or object.

From the foregoing observations we learn, that the quantity of refraction over the surface of water may be very considerable, where the land is near enough to influence the temperature of the air. At sea, however, so great differences of temperature cannot be expected; and and the increase of dip caused by this variation of horizontal refraction, it is to be presumed, is not so great as in the confined course of a river; but, if we consider that it may also be subject to an equal diminution from an opposite cause, and that the horizon may even become apparently elevated, there can be no question that the

the error in nautical observations, arising from a supposition that it is invariably according to the height of the observer, stands in need of correction.

The remedy employed by Mr. Huddart *, of taking two angles of the sun from opposite points of the horizon at the same time, and considering the excess of their sum above 180° as double the dip, must without doubt be effectual; but, from causes which he assigns, it is practicable only within certain limits of zenith distance; for, where the zenith distance is small, and the changes of azimuth rapid, there is required considerable dexterity and steadiness of a single observer who attempts to turn in due time, from one observation to another; and when it exceeds 30°, the greater angle cannot be measured with a sextant, and consequently his method is, with that instrument, of use only in low latitudes.

On account of the difficulty attending some of the adjustments for the back observation, he rejects that method for taking angles in general, with much reason; but he has thereby overlooked a means of determining the dip, which I am inclined to think might be employed with advantage in all latitudes, without any occasion to hurry the most inexperienced or cautious observer.

By the back observation, the whole vertical angle between any two opposite points of the horizon may be measured at once, either before or after taking an altitude. Half the excess of this angle above 180° should of course be the dip required.

But if it be doubtful whether the instrument is duly adjusted, a second observation becomes necessary. The instrument must be reversed, and, if the apparent deficiency of the opposite angle from 180° be not equal to

* Phil. Trans. for 1797, p. 40.

the excess before obtained, the index error may then be corrected accordingly; and, since the want of adjustment, either of the glasses at right angles to the plane of the instrument, or of the line of sight parallel to it, will affect both the larger and smaller angles very nearly in an equal degree, the $\frac{1}{2}$ part of their difference will be extremely near the truth, and the errors arising from want of those adjustments may with safety be neglected.

This method of correcting the index error for the back observation at sea was many years since recommended by Mr. Ludlam *; yet I do not find that it has been noticed by subsequent writers on that subject, or suggested by any one for determining the dip; but I can discover no reason for which it could be rejected as fallacious, and I should hope that in practice it would be found convenient, since in theory it appears to be effectual.

The most obvious objection to this, as well as to Mr. Huddart's method, is the possibility that the refraction may be in some measure different in opposite points of the horizon at the same time. When land is at no great distance, such an inequality may be found to occur; but, upon the surface of the ocean in general, any partial variations of temperature can rarely be supposed to exist; and it is probable, that under any circumstances, the difference will not bear any considerable proportion to the whole refraction; nor can it be thought a sufficient reason for rejecting one correction proposed, that there may yet remain other smaller errors, to which all methods are equally liable, but which it is not the object of the present dissertation to rectify.

* Directions for the use of Hadley's quadrant, 1771, § 82, p. 56.

On

On a rich and cheap Compost. *By* A. Hunter, *M. D.*

From Hunter's Georgical Essays.

IN the Essay on the Nourishment of Vegetables *, I endeavoured to show that oil, made miscible with water, constitutes the chief nourishment of vegetables. A greater number of proofs might have been produced in support of that doctrine; but I flatter myself that those already advanced will be thought sufficient.

Having reason to believe that my theory was founded upon facts and experiments, I was desirous of converting it to public utility. And as I apprehended that a compost might be discovered, upon the principles advanced, which would come cheap to the farmer, and be of easy carriage, I diligently employed myself in prosecuting the inquiry.

In the course of investigation I took care to reason upon proper data; carefully avoiding every degree of partiality to my system.—In philosophy nothing is so delusive as prejudice.

After making various trials, I at last discovered what I so ardently sought after; but as I have not the vanity to think my experiments sufficiently conclusive, I embrace this opportunity to request the assistance of the practical farmer, in order that the merits of the invention may be fully determined.

Should my theory concerning the food of plants be found erroneous, the compost of course will be disregarded. But, on the contrary, should it be agreed to, that oil, under certain modifications, made miscible with water, constitutes the chief nourishment of vegetables,

* See the last Number of this work, page 349.

then

then the invention will probably become a subject for future experiment.

Though theory may direct our inquiries, yet experience must at last determine our opinions, for which reason I propose to enlarge my experiments; and as I have no other view but the investigation of truth, I shall lay them faithfully before the public, whether they prove successful or not.

We know that a number of experiments, made by different persons, and in different places, are essentially necessary towards establishing the truth of any received opinion in agriculture. How much more necessary is it to request the assistance of the practical farmer, in determining the merits of a new invention? for such I esteem the compost I here communicate.

Virgil, indeed, has recommended the lees of oil as a manure, and the ingenious Dr. Home has mentioned olive oil; but neither of them reflected upon the absolute necessity of rendering the oil miscible with water, by means of an alkaline salt.

I judge it unnecessary to repeat what I have already advanced upon the food of plants. I shall therefore refer the reader to the first Essay, as it contains the greatest part of the reasoning upon which the following compost is founded.

To make Oil-Compost.

	l.	*s.*	*d.*
Take North-American potash 12 lb. . . .	0	4	0
Break the salt into small pieces, and put it into a convenient vessel with four gallons of water. Let the mixture stand forty-eight hours, then add course train-oil, 14 gallons	0	14	0
	£0	18	0

In

In a few days the salt will be dissolved, and the mixture, upon stirring, will become nearly uniform.

Take fourteen bushels of sand, or twenty of dry mould. Upon these pour the above liquid ingredients. Turn this composition frequently over, after adding to it as much fresh horse-dung as will bring on heat and fermentation; in six months it will be fit for use.

I apprehend that the above quantity will be found sufficient for an acre: my trials, however, do not give me sufficient authority to determine upon this point.

For the convenience of carriage, I have directed no more earth to be used than will effectually take up the liquid ingredients. But if the farmer chooses to mix up the compost with the mould of his field, I would advise him to use a larger portion of earth, as he will thereby be enabled to distribute it with more regularity upon the surface. I have not yet had any extensive trial of its efficacy upon pasture and meadow grounds: but I presume that whatever will nourish corn, will also feed the roots of grass. When used upon such lands, it should be put on during a rainy season, as all top-dressings are injured by the solar heat.

All kinds of cattle must be kept off the lands for some time, as they will bite the grass too close in quest of the salt contained in the compost, which I have found to be the case in small trials.

I shall here observe, that the oil-compost is only intended to supply the place of rape-dust, soot, woollen rags, and other expensive hand-dressings. It is in all respects inferior to rotten dung: where that can be obtained, every kind of manure must give place to it.

At the same time that dung affords nourishment, it opens the pores of the earth. Hand-dressings, on the contrary, give food to plants, but contribute little towards

wards loosening the soil. This is an useful and practical distinction, and may be applied through all the variety of manures made use of by the farmer.

I presume that the oil-compost resembles the natural food of plants; but I submit that, as well as every thing else, to experience, our unerring guide.

It may be objected, that it has not sufficiently undergone the *putrid ferment*, to attenuate the oily particles. The use of rape-dust, soot, horn-shavings, and woollen rags, take off that objection, and at the same time confirm the theory upon which the above compost is founded.

I do not take upon me to direct the experienced farmer in the manner of using this new compost. I would have every person apply it in the way most agreeable to himself. Many things will occur to the practical husbandman, that no reasoning of the philosopher could foresee. By attending to the different ways of using it, we may reap considerable advantages. Improvements may be collected even from the highest degree of mismanagement.

Facts must ever be the foundation of our reasoning. Without them the philosopher is a kind of *Ignis fatuus*. Instead of unfolding nature, he covers her with a cloud, and endeavours, as it were, to bring old Chaos back again into the world.

Should I presume to instruct the farmer in the management of the compost, I would recommend it to be sown immediately after the grain, and both harrowed in together.

The following experiment, though trifling in its own nature, gave me the first encouragement to prosecute the subject upon a larger scale.—I took four pots, Nos. 1, 2, 3, 4.

No. 1.

No. 1 contained 12 lb. of barren sand with 1 oz. of the sand oil-compost.

No. 2—12 lb. of sand, without any mixture.

No. 3—12 lb. of sand, with ½ oz. of slaked lime.

No. 4—12 lb. of sand, with 4 oz. of the sand oil-compost.

In the month of March I put six grains of wheat into each pot, and during the summer I occasionally watered the plants with filtered water. All the time that the plants were consuming the farina, I could observe but little difference in their appearance. But after one month's growth I remarked that No. 1 was the best. No. 2, the next. No. 3, the next. No. 4, much the worst.

In August I made the following observations:

No. 1 had five small ears, which contained a few poor grains.

No. 2 had three small ears, which scarce deserved the name of ears, containing a few grains, much inferior in goodness to the former.

No. 3 had no ears. Only I observed two very small ones within their respective sheaths, which, for want of vegetable strength, never made their appearance.

No. 4 had no ears; the stalks appearing stunted in their growth.

I removed the plants from their pots, and took a view of the roots of each.

No. 1. The roots tolerable large, and well spread.

No. 2. The roots not so large.

No. 3. The roots very short and small.

No. 4. The roots much the shortest, with the appearance of being ricketty.

Upon this experiment I remark:

1. That the oil-compost may be considered as a vegetable food; but that, when used too liberally, the alkaline

salt will burn up the roots of the plant, and hinder vegetation. For which reason I would recommend the compost to be exposed to the influence of the air for some months before it is laid on.

2. That lime contains no vegetable food, and is, in its own nature, an enemy to vegetation. It is, however, of excellent use in assisting vegetation, in the manner described in the Essay on the Nourishment of Vegetables.

My experiments teach me, that all kinds of soils may be benefited by this manure. The limestone, gravelly, sandy, and chalky soils seem to require it most. The rich loams and good clays have nourishment within themselves, and stand more in need of the plough than the dunghill.

It is observed by farmers, that rape-dust seldom succeeds with spring-corn unless plentiful rains fall within a few weeks after sowing. I have more than once made the same observation upon the oil-compost, which induces me to recommend it for winter crops only. From the unctuousness of its nature, it is more than probable, that it should lie exposed for a long time to the influence of the weather, which benefit it is deprived of when used for barley, and such crops as are sown late in the spring. I am confirmed in this idea from repeated experiments made with the compost upon turnips, which generally proved unsuccessful. But at the same time I invariably found that those parts of the field on which the compost had been spread produced the best crops of grain the following year. From this slow manner of giving its virtues, it seems to be an improper dressing for all plants that have a quick vegetation.

Agreeably to the theory advanced in the first Essay, I presume that all lands, which have been exhausted by frequent crops, are robbed of their oily particles, and consequently

consequently have become barren. The oil-compost, as it plentifully restores particles similar to those that are carried off, has a fair appearance of proving an excellent restorative. To lands under such circumstances lime alone is the worst manure that can be applied.

This last observation naturally leads me to wish for a general history of manures, upon sound and rational principles. I cannot help regarding that necessary part of husbandry as a subject but imperfectly understood. Whoever succeeds in that difficult task will prove himself a real friend to mankind. Without it agriculture must remain a vague and uncertain study.

Observations on the Process of Tanning.

By Mr. Davy.

From the Journals of the Royal Institution of Great Britain.

I. *On the Preparation of Skin for Tanning.*

IN all the processes for forming leather, the skins are depilated, and freed from flesh and extraneous matter before they are submitted to the action of the tanning lixivium. In some cases, when large skins are employed, a slight degree of putrefaction is induced, for the purpose of enabling the hair to be readily separated; but in general this effect is produced by a mixture of lime and water.

The process by putrefaction is so simple as to require no comment: the epidermis is loosened by it, and the cellular substance that constitutes the bulb of the hair softened in such a manner that it may be easily separated from the cutis or true skin.

When lime is employed, it has been generally supposed that it acts by destroying the epidermis, so as to render it soluble in water. This, however, does not appear to be the case: I exposed to two ounces of lime-water four grains of epidermis, separated from cow-skin, and which had been freed from loose moisture by blotting-paper; but, after five days, it appeared rather of larger volume than before; and instead of having lost any weight, I found that it had gained very nearly half a grain.

The epidermis has been supposed to consist of coagulated albumen. In comparing its properties with those of the coagulated white of the egg, there was a striking analogy perceived between them: both were soluble in the caustic alkalies by long exposure, and were acted upon by the acids.

In examining the circumstance of the action of lime-water, and of milk of lime, upon skin, I have always observed that the cuticle is rendered extremely loose and friable after the action: from which it is probably that it combines with the lime, so as to form an insoluble compound. This may be observed indeed in washing the hands with lime-water: the cuticle becomes extremely rough and dry; whereas, after the action of weak alkaline solutions, which form soluble compounds with it, it is found smooth.

Not only the epidermis, but likewise the soft matter at the extremity of the hair, is acted upon by lime; and this effect must tend considerably to facilitate the process of depilation. Likewise the fat and oily matter adhering to the skin, from saponaceous compounds with the earth, and these compounds are removed with other extraneous matter, before the skins are submitted to any new chemical agents.

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It has been proposed to use the residuum of the tanning lixivium or the exhausted ooze, for the purposes of depilation; but this liquor seems to contain no substances capable of acting upon the epidermis, or of loosening the hair; and when skin is depilated by being exposed to it, the effect must really be owing to incipient putrefaction.

Skins, after being depilated and cleansed, are in this country generally subjected to other processes of preparation before they are impregnated with the tanning principle.

The large and thick hides which have undergone incipient putrefaction, are introduced for a short time into a strong infusion of bark, when they are said by manufacturers to be *coloured*; and after this they are acted upon by water impregnated with a little sulphuric acid, or acetous acid formed by the fermentation of barley or rye. In this case they become harder and denser than before, and fitted, after being tanned, for the purpose of forming the stouter kinds of sole leather. The acids are capable of combining both with skin and with tannin; and it would appear that, in this process, a triple combination must be effected on the surface of the skin, though from theory one should be disposed to conclude, that the interior part could be little modified in consequence of the colouring, and the action of the acids.

The light skins of cows, the skins of calves, and all smaller skins, are treated in a very different way, being submitted for some days to the action of a lixivium, called the grainer, made by the infusion of pigeons-dung in water. After this operation they are found thinner and softer than before, and more proper for producing flexible leather. When the infusion of pigeons-dung is examined, after being freshly made, it is found to contain a little

little carbonate of ammonia, but in a short time it undergoes fermentation, when carbonic acid and hydrocarbonate are given out by it, and a small quantity of acetous acid formed. The alkali in the grainer may probably have some action upon the skin; it may be supposed to free it from any oils or calcareous soap that remained adhering to it: but the great effect probably depends upon the complicated process of fermentation, during which the skin loses its elasticity, and becomes soft; and it is found by tanners, that dung which has undergone fermentation is wholly unfit for their use.

I have tried several experiments on different substances, as substitutes for the pigeons-dung used in the grainer, but without gaining successful results. Very weak solutions of carbonate of potash and carbonate of ammonia seemed to soften considerably small pieces of skin that had been depilated by lime; but when they were tried by Mr. Purkis, in the processes of manufacture, the effects were less distinct. In the western counties of England the excrement of dogs is employed instead of pigeons dung, and culver, or the dung of fowls is in common use. The dung of graminivorous quadrupeds enters only slowly into fermentation, and it is not found efficacious in the process.

II. *On the Impregnation of Skin with the Tanning Principle.*

The tanning lixivium or ooze is generally made in this country, by infusing bruised or coarsely powdered oak-bark in water.

Skins are tanned by being successively immersed in lixiviums, saturated in different degrees with the astringent principles of the bark. The lixiviums first employed are usually

usually weak; but for the completion of the process they are made as strong as possible.

In the process of tanning, the skin gains new chemical properties; it increases in weight, and becomes insoluble in boiling water.

The infusions of oak-bark, when chemically examined, are found to contain two principal substances; one is precipitable by solution of gelatine, made from glue or isinglass; and gives a dense black with solution of common sulphate of iron. The other is not thrown down by solution of gelatine; but it precipitates the salts of iron of a brownish black, and the salts of tin of a fawn colour.

The substance precipitable by solution of gelatine is the tanning principle, or the tannin of Seguin. It is essential to the conversion of skin into leather, and in the process of tanning it enters into chemical union with the matter of skin, so as to form with it an insoluble compound. The other substance, the substance not precipitable by gelatine, is the colouring or extractive matter; it is capable of entering into union with skin, and it gives to it a brown colour; but it does not render it insoluble in boiling water.

It has been usually supposed that the infusion of oak-bark contains a peculiar acid, called gallic acid; but some late experiments render this opinion doubtful: and this principle, if it exists in oak-bark, is in intimate combination with the extractive or colouring matter.

In the common process of tanning, the skin, which is chiefly composed of gelatine, slowly combines in its organized form with the tannin and extractive matter of the infusions of bark; the greater proportion of its increase of weight is however owing to tannin, and it is from this substance the leather derives its characteristic properties;

but

but its colour, and the degree of its flexibility, appear to be influenced by the quantity of colouring matter that it contains.

When skin, in large quantity, is suffered to exert its full action upon a small portion of infusion of bark, containing tannin and extractive matter, the fluid is found colourless. It gives no precipitate to solution of glue, and produces very little effect upon the salts of iron, or of tin.

The tanning principle of oak-bark is more soluble in water than the extractive matter. And the relative proportion of tannin to extractive matter is much greater in strong infusions of oak-bark, than in weak ones; and when strong infusions are used for tanning, a larger proportion of tannin is combined with the matter of skin.

For calf-skins, and light cow-skins, which are usually prepared in the grainer, weak lixiviums are used in the first part of the process; but thick ox-hides, for the purpose of stout sole-leather, are generally kept in a strong ooze, preserved constantly in a state approaching to saturation, by means of strata of bark.

Calf-skins, and light cow-skins, in the usual process, require for their full impregnation with tannin from two to four months; but thick ox-hides demand from ten to eighteen months.

In any case the state of the skin with regard to impregnation with tannin may be easily judged of, if it be cut transversely with a sharp knife: in this case the tanned part appears of a nutmeg colour; but the unimpregnated skin retains its whiteness.

The tanned hides designed for sole-leather are, while drying, generally smoothed with a stout steel pin, and beat with a mallet. By this process they are rendered

denser,

denser, firmer, and less permeable to water: calf-skins are not subjected to the operation of beating; and they are treated in different ways by the currier, according as they are needed for different purposes.

III. *General Remarks relating to the Processes of Tanning.*

A very great number of vegetable productions, besides oak-bark, contain the principle essential to the conversion of skin into leather: galls, sumach, the bark of the Spanish chesnut, of the elm, of the common willow, and of the Leicester willow, the branches of the myrtle, tormentil, and heath, have all been used in the processes of tanning.

Different methods have been proposed for estimating the quantity of tannin in different vegetable productions. Tannin by being dissolved in water increases its specific gravity, and the hydrometer has been used for estimating the strength of the tanning ooze. The results given by this instrument are, however, often fallacious in comparative experiments, in consequence of the presence of extractive matter, and of saline substances; and the action of the solution of gelatine affords the best indication of the quantity of the tanning principle.

The solution of gelatine most proper for the general purposes of experiments, is made by dissolving an ounce of glue, or of isinglass, in three pints of boiling water.

The substance to be examined as to its tanning power, may be used in the quantity of two ounces; it should be in a state of coarse powder, or in small fragments. A quart of boiling water will be sufficient to dissolve its astringent principles.

The solution of glue, or gelatine, must be poured into the astringent infusion, till the effect of precipitation is at an end.

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The turbid liquor must then be passed through a piece of blotting-paper, which has been before weighed.

When the precipitate has been collected, and the paper dried, the increase of its weight is determined; and about two-fifths of this increase of weight may be taken as the quantity of tannin in the ounce of the substance examined.

When solution of gelatine cannot be obtained, a solution of albumen may be used. It is made by agitating the white of an egg in a pint of cold water. It does not putrefy nearly so readily as the solution of glue, and it may be employed with equal advantage in experiments of comparison; but the composition of the precipitates it forms with tannin, has not as yet been ascertained.

The tanning principle in different vegetables is possessed of the same general characters; but it often exists in them in states of combination with other substances.

In galls it is in union with the gallic acid. In sumach it is mixed with saline matter, particularly sulphate of lime; and in the greater number of barks it is in combination with mucilage and different extractive and colouring matters.

Leather tanned by means of different astringent infusions differs considerably in its composition; but it seldom contains more than one-third of its weight of vegetable matter.

Gallic acid, and the saline matters in general, in cases when they are combined with tannin, are not absorbed with it by skin; but they remain in their primitive forms.

The leather made from infusions of Aleppo galls, and of sumach, is composed probably of pure tannin and the matter of skin. Its colour is very pale, and the increase of weight is greater than in most other cases.

Extractive,

Extractive, or colouring matters, in cases when they exist in astringent infusions, as in the instance of oak-bark already mentioned, are wholly or partly absorbed with the tannin by the skin. The leather from barks in general is coloured, and contains different proportions of extractive matter.

Of all the substances that have been examined as to their tanning properties, catechu or terra japonica, is that which is richest in the tanning principle. This substance is the extract of the wood of a species of the mimosa, which grows abundantly in India; and calculating on its price, and on the quantities in which it may be procured, there is great reason to believe that it may be made a valuable article of commerce.

In a paper published in the Philosophical Transactions for 1803, a statement is given of the comparative value of different astringent substances, oak-bark being considered as the standard.

The attraction of tannin for water is much stronger than that of any other of the principles usually found in astringent vegetables; and the saturated infusions obtained from substances containing very different proportions of astringent matters, are usually possessed of the same degree of strength with regard to their tanning powers.

When saturated solutions of the tanning principle are used in the process of manufacture, the leather is tanned in a much shorter time than in the common operation with weaker infusions. The rapid method of tanning has been recommended by M. Séguin; and is ably described in a pamphlet published by Mr. Desmond.

It has however been generally observed, that leather too quickly tanned is more rigid, and more liable to crack than leather slowly tanned. And there is every reason to

believe that its texture must be less equable, as the exterior strata of skin would be perfectly combined with tannin before the interior strata were materially acted upon; and the want of colouring or extractive matter in the strongest lixivium in many cases must affect the nature of the leather.

The substances used for tanning should, in all cases, be preserved in as dry a state as possible before they are used. When they are exposed to moisture and air, the tanning principle by degrees is destroyed in them, and for the most part converted into insoluble matter.

The process of drying bark by heat, when carefully conducted, must, as there is great reason to believe, on the whole be advantageous. The tanning principle is not decomposed at a temperature below 400°. And in fresh vegetable substances, tannin appears to be sometimes developed or formed by the long application of a low heat: this fact I observed with my friend Mr. Poole in September 1802, with regard to acorns; and I have since made the same remark upon the horse-chesnut.

Comparison of the French definitive Metre with an English Standard, brought from London by M. A. PICTET, *one of the Editors of the Bibliothêque Britannique.*

From the BIBLIOTHEQUE BRITANNIQUE.

THE measurement of the earth, and the investigation of its figure, were the subjects, at various times in the course of the eighteenth century, of the labours of a number of philosophers of the first eminence in different countries. Some Swedish Astronomers are now employed in a second measurement of the same degree which

which was measured sixty years ago by the French Academicians in Lapland, under the polar circle. In France, when the idea of seeking in the dimensions of the globe itself the unit to which all measures and weights might be referred, had once been conceived and adopted, it was necessary to make an effort proportional to the importance of an undertaking which was thus become national. In the midst of a long and sanguinary war, together with difficulties of every other kind, a chain of triangles has been formed between Dunkirk and Barcelona, comprehending the tenth part of the arc of the meridian which extends from the Equator to the pole, and which is equal to one-fourth of the circumference of the globe; and the ten millionth part of this arc, thus determined, has been adopted for the unit of the metrical system: it has been fixed by the construction of standards made of substances proper to resist the attacks of time; and by a careful examination of the precise relation of the length of the metre to that of the pendulum vibrating seconds, on the level of the sea, in a given latitude, the determination of this unit has been rendered independent of any accident that might destroy or impair the standards representing it; while in the formation of these standards all the precautions have been employed that could be suggested by the present improved state of natural philosophy, and of the arts.

In England, on the other hand, operations have been carried on for these five and twenty years, which are to be the foundations of an exact map of Great Britain. These labours, begun by the late General Roy, have been conducted with much sagacity and precision; and the results are likely to procure very interesting information respecting the figure of the earth. Sir George Shuckburgh, an eminent member of the Royal Society

of

of London, has successfully employed himself in private, in researches intended to fix the precise length of the standards, which have served as bases for the measurements made in Great Britain.

It was therefore to be regretted, that operations so similar, conducted in two neighbouring countries, and capable of acquiring a new interest by comparison, should remain unconnected, for want of an actual standard of the measures of the one country, which might be transported into the other, after the definitive determination of the French measure. This regret we had deeply felt at various times when these objects were laid before our readers; and we may say with truth, that if the hope of procuring this medium of comparison was not the only motive of the journey to England that one of us has made, it at least greatly contributed to induce him to undertake it.

Our colleague took some steps in his passage through Paris, to obtain an authentic metre, in order to be submitted to the examination of the Royal Society, to which he has the honour of belonging, but he did not remain long enough in Paris to be able to succeed in this attempt. He took advantage of his longer stay in England, in procuring from the hands of Mr. Troughton, an artist celebrated for his accuracy in the construction and division of geometrical and astronomical instruments, a standard rigorously conformable to that which he had made for Sir George Shuckburgh, and with which this philosopher had compared the principal English standards. Our colleague procured also from the same artist the comparative apparatus of Sir George Shuckburgh, composed of two excellent microscopes, the one bearing a micrometer which divides the English inches into ten thousand equal parts. Upon his return to Paris he made haste to exhibit

exhibit these instruments to the minister of the interior, and to the National Institute. This learned body, nominated three of its members in order to proceed to the regular comparison of the definitive metre with the English standard. The undertaking, by no means so easy as it at first appeared, occupied the committee in five different meetings, of nearly four hours each; and it was performed with all the care and precaution that the nature of the subject required. M. Prony, who, as the translator of General Roy's memoir on the first trigonometrical operations in England, was particularly interested in these researches, acted as secretary to the committee, and it was at his house, and with the assistance of a comparative apparatus belonging to him, that the principle experiments were made. He has been so obliging as to furnish us with an authentic copy of the report made to the Institute, which was deemed of sufficient consequence to be read at the public sitting of the last quarter.

National Institute of Sciences and Arts. 6 *Nivose, Year* 10, (27*th December*, 1801.)

A member read, in the name of a committee, the following report on the comparison of the standard metre of the Institute with the English foot.

M. Pictet, Professor of Natural Philosophy at Geneva, submitted to the inspection of the class, in the month of Vendémiaire, an interesting collection of objects relative to the sciences and arts, which he collected in his journey to England.

Among them was a standard of the English linear measure, engraved on a scale of brass, of 49 inches in length, divided by very fine and clear lines into tenths of an inch.

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It was made for M. Pictet by Troughton, an artist in London, who has deservedly the reputation of dividing instruments with singular accuracy; it was compared with another standard made by the same person for Sir George Shuckburgh, and it was found that the difference between the two was not greater than the difference between the divisions of each; that is, it was a quantity absolutely insensible. This standard may therefore be considered as identical with the standard described by Sir George Shuckburgh, in the Philosophical Transactions for 1798.

M. Pictet also exhibited to the Institute a comparer, or an instrument for ascertaining minute differences between measures, constructed also by Mr. Troughton. It consists of two microscopes with cross wires, placed in a vertical situation, the surface of the scale being horizontal, and fixed at proper distances upon a metallic rod. One of them remains stationary at one end of the scale, the other is occasionally fixed near to the other end; and its cross wires are moveable by means of a screw, describing in its revolution $\frac{1}{100}$ of an inch, and furnished with a circular index, dividing each turn into 100 parts; so that having two lengths which differ only one-tenth of an inch from each other, we may determine their difference in ten thousandths of an inch. The wires are placed obliquely with respect to the scale, so that the line of division must bisect the acute angle that they form, in order to coincide with their intersection. General Roy has described, in the 75th volume of the Philosophical Transactions, a similar instrument made by Ramsden, for measuring the expansion of metals.

M. Pictet offered to the class the use of the standard, with the micrometer described, for the determination of the comparative length of the metre, and the English

foot;

foot: the offer was accepted with gratitude, and Messrs. Legendre, Méchain, and Prony, were appointed to co-operate with M. Pictet in the comparison of the standard metre of platina and the English foot.

The first meeting was on the 28th Vendémiaire, (21st of October,) at the house of M. Lenoir.

At first a difficulty occurred from the different manner in which the measures were defined: the English scale was graduated by lines; the French standards were simply cut off to the length of a metre: hence the length of the metre could not easily be taken by the microscopes; nor could the English scale be measured by the method employed for making new standard metres, which consists in fixing one end against a firm support, and bringing the other into contact with the face of a cock or slider, adjusted so as barely to admit the original standard between it and the fixed surface.

M. Lenoir attempted to overcome this difficulty by reducing to a thin edge the terminations of a piece of brass of the length of a metre; so that it was compared with the standard metre in the usual manner, and its extremities, when placed on the English scale, constituted two lines parallel to those which were really engraved on the scale, and capable of being viewed by the microscopes.

The standard metre of platina, and another standard of iron, belonging also to the Institute, were thus compared with the English foot; each of these two measures being equal, at the temperature of melting ice, to the ten millionth part of the quadrant of the meridian. At the temperature of 15.3° of the decimal thermometer, or 59.5° of Fahrenheit, the metre of platina was equal to 39.3775 English inches; and that of iron to 39.3788, measured on M. Pictet's scale.

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These first experiments showed, however, that the method employed was liable to some uncertainty, arising from the difficulty of placing the cross wires precisely at the extremity of the thin edge of the plate of brass employed in the comparison; a reflection of irradiation of light, which took place at that extremity, prevented its being distinctly observed if the optical axis of the microscope was precisely a tangent to the surface exactly at the termination.

In order to remove this inconvenience, another arrangement was proposed by one of the committee. (It was M. Prony that suggested this ingenious method, and M. Paul, of Geneva, who happened to be present, that executed it. B. B.) A line was traced on a small metallic ruler, perpendicular to its length; the end of the ruler was fixed against a solid obstacle, and the cross wires made to coincide with the line: the standard metre was then interposed between the same obstacle and the end of the piece, and the line traced on it, which had now obviously advanced the length of the metre, was subjected to the other microscope. The microscopes thus fixed, were transferred to the graduated scale; one of them was placed exactly over one of the divisions, and the micrometer screw was turned in order to measure the fraction, expressing the distance of the other microscope from another division.

The comparison was repeated in the same manner the 4th Brumaire (26th October) last, at the house of one of the committee, and, after several experiments, agreeing very satisfactorily with each other, it was found that at the temperature 12.75°, or 55° of Fahrenheit, the standard of platina was 39.3781, and that of iron 39.3795 English inches.

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The two metres being intended to be equal at the temperature of melting ice, these operations may be verified by reducing their results to that temperature. For this determination we are provided with the accurate experiments made by Borda, and the committee of weights and measures, on the dilatation of platina, brass, and iron; from which it appears, that for every degree of the decimal thermometer, platina expands .00000856; iron .00001156; and brass .00001783; for Fahrenheit's scale these quantities become 476,642, and 990 parts in a hundred millions. From these data we find that, at the freezing point, the standard metre of platina was equal to 39.38280, and that of iron to 39.38265 English inches of M. Pictet's scale. The difference is less than the 500th of a line, or the 200000th of the whole metre, and is therefore wholly inconsiderable.

The result of the whole comparison is therefore this. Supposing all the measures at the temperature of melting ice, each of the standard metres is equal to the 10000000th part of the quadrant of the meridian, and to 39.38272 English inches of M. Pictet's scale.

At the class of mathematical and physical sciences of the National Institute, 6 Nivose, year 10.

Legendre, Méchain, and Prony, *Reporters.*

This report is approved, and its conclusions adopted by the class. Certified by Delambre.

Paris, 26 Nivose, year 10 (16th January, 1802).

The following remarks are by Dr. Young, of the Royal Institution.

On examining the reduction of the standards of platina and iron to the freezing point, it appears that they differ somewhat less than is stated in the report, and that they coincide within an unit in the last piece of the decimals

expressing their magnitudes, or one ten thousandth of an inch. The standard of platina at the freezing point becomes equal to 39.37380, and that of iron to 39.37370 English inches on the scale of brass at 55°, and the mean of these to 39.37100 English inches at 62°, which is the temperature that has been universally employed in the comparison of British standards, and in the late trigonometrical operations in particular. This result agrees surprisingly with Mr. Bird's determination of the lengths of the toises sent by M. Lalande to Dr. Maskelyne, of which the mean was 76.754 inches: hence the metre, having been found to contain 36.9413 French inches, appears to be equal to 39.3702 English inches: or rather to be either 39.3694 or 39.3710, accordingly as the one or the other of the two toises happens to have been the more correct; we may therefore give the preference to that which measured 76.736 inches.

Allowing the accuracy of the French measurements of the arc of the meridian, the whole circumference of the globe will be 24855.43 English miles, and its mean diameter 7911.73. Taking the ellipticity at $\frac{1}{310}$, the axis will be nearly $7893\frac{1}{2}$, the equatorial diameter 7928, and the diameter of a sphere of equal solid content about 7916 miles; the brass standard being at the temperature of 62° of Fahrenheit.

As long, therefore, as the English standard continues to be reduced to this temperature, we must consider the metre as equivalent to 39.3710, and not to 39.3827 English inches.

Upon these joint authorities it may be of use to reprint here a table of the principal measures and weights now used in France, with the very slight corrections which this last comparison has introduced into it. In translating the French terms into English, we are fully at liberty

liberty to rescue them, in some measure, from the barbarisms in orthography which have been committed in forming them.

Measures of Length, the Metre being at 32°, the Foot at 62°.

	English Inches.
Millimetre	.03937
Centimetre	.39371
Decimetre	3.93710
Metre	39.37100
Decametre	393.71000
Hecatometre	3937.10000
Chiliometre	39371.00000
Myriometre	393710.00000

	M.	F.	Y.	Ft.	In.
A decametre is	0	0	10	2	9.7
A hecatometre	0	0	109	1	1
A chiliometre	0	4	213	1	10.2
A myriometre	6	1	156	0	6

8 chiliometres are nearly 5 miles.

Measures of Capacity.

	Cubic Inches E.
Millilitre	.06103
Centilitre	.61028
Decilitre	6.10280
Litre, a cubic decimetre	61.02800
Decalitre	610.28000
Hecatolitre	6102.80000
Chiliolitre	61028.00000
Myriolitre	610280.00000

A litre is nearly $2\frac{1}{8}$ wine pints. 14 decilitres are nearly 3 wine pints. A chiliolitre is 1 tun, 12.75 wine gallons.

Weights.

Weights.

A gramme is the weight of a cubic centimetre of pure water at its maximum of density. It has been found equal to 18.827 French grains, of which 576 made 472.5 English; and 489.5058 grammes make a pound of the standard of the mint at Paris.

	E. Grains.
Milligramme	.0154
Centigramme	.1544
Decigramme	1.5444
Gramme	15.4440
Decagramme	154.4402
Hectogramme	1544 4023
Chiliogramme	15444.0234
Myriogramme	154440.2344

A decagramme is 6 dwts. 10.44 gr. tr.; dr. iisc. gr. 4.44 apoth.; or 5.65 dr. avoird. A hecatogramme is 3 oz. 8.5 dr. av. A chiliogramme is 2 lbs. 3 oz. 5 dr. av. A myriogramme is 22 lbs. 1.15 oz. av. 100 myriogrammes are 1 ton wanting 32.8 lbs.

Agrarian Measures.

Are, 1 square decametre	3.95 perches.
Hecatare	2 acres, 1 rood, 35.4 perches.

For Fire-wood.

Decistere, $\frac{1}{10}$ stere	3.5317 cub. f. E.
Stere, 1 cubic metre	35.3171 cub. f.

MONEY. *Copper.*

	E. Grains.
Centime, 1 gramme	15.4
5 centimes, or sous	77.2
Decime	154.4
2 decimes	308.8

Silver

Silver $\frac{9}{10}$ or $\frac{36}{40}$ fine.

Franc, 5 grammes	3 dwts. 5.2 gr.
5 francs	16 dwts. 2.1 gr.

The franc is nearly the same with the livre tournois, and worth about 10 d. Bolton's penny weighs 435 gr.; his halfpenny 165; a shilling nearly 93 gr. $\frac{37}{40}$ fine.

It appears from Mr. Borda's experiments, that in latitude 45°, a pendulum of the length of a metre would perform in a vacuum 86116.5 vibrations in a day: the length of a pendulum being supposed to increase with the latitude, in the proportion of the square of the sine of the latitude, multiplied by .000567, while the time of its vibration remains unaltered.

Process by which Eight Hundred to Eight Hundred and Twenty Pounds of Corn yield Four Hundred Thirty-two to Four Hundred Forty-eight Quarts of the best Brandy.

From WESTRUMB's "Observations for the Use of Distillers."

TAKE eight hundred to eight hundred and twenty pounds of corn, good weight, and make it sprout: for this purpose either pure wheat or rye may be employed, or add one-third of malted barley, and mix them before they are ground.

To form the first paste after the corn is ground, the water should not be hotter than 30° of Reaumur. If that liquid contain carbonic acid it should be heated to ebullition, and afterwards suffered to cool to the degree specified. When the water contains none of that acid, mix three parts of that liquid, when boiling, with one part of cold

cold water, and let it stand to cool a few moments. Take three parts of this water to two parts of ground corn, according to a measure corresponding to the weight, and mix the water well with the corn, to form an equal paste, free from lumps. In this manner the first distillation is begun in autumn: for the succeeding ones, the water remaining from the first distillation is used, after being left to cool to 38°, and then the paste is made with it. This water augments the quantity of brandy produced.

For diluting employ boiling water; pour it slowly upon the paste, continuing to beat it up; add five parts of water to one of paste, which makes the mixture consist of eight parts of that liquid and two parts of corn.

Then cover the tub or vat containing the matter, and leave it covered two hours. At the expiration of that time uncover it for four hours, for the purpose of reducing the heat, and the cooling may be promoted by stirring the matter every five minutes.

After this add ten parts more of cold water, and beat up the whole with care. This addition will give the preparation the necessary degree of dilution, and will reduce it to a temperature that cannot exceed 17½°, nor be under 16° of Reaumur. Instead of water, as much clear liquor as the operator has at his disposal may be employed. For this purpose draw off, after every first distillation, all the liquor above the pulp, and let it cool in large tubs. This clear liquor considerably augments the quantity of brandy that is obtained.

Then add 60 pounds of yeast to 800 pounds of corn. To prevent the sour portion which remains in the vat, and which it is impossible to take out, from turning the whole mixture sour, and to disengage a certain quantity of carbonic acid, add 1¼ ounce of good potash, or a pound

pound of good wood-ashes sifted, and well beat up the matter.

The vat must then be covered for eighteen hours; after which half uncover it, and when the temperature encreases uncover it entirely after six hours more; if attention were not paid to this particular, a great part of the spirit would be volatilised. If a white froth appear upon the surface it is a sign that the fermentation proceeds as it ought. Forty-eight hours after the mixture of the paste, the pulp begins to rise; this disposition is promoted by gently stirring the matter, and covering the vat a second time. In seventy-two to ninety hours, the whole becomes clear, and the fermentation is finished.

The vats must not be larger than to supply one or at most two distillations. The distilled liquor is rectified every day to half proof, and only to whole proof when there is sufficient to fill the still.

For distilling in summer, take a sixth part less of corn to the quantity of water prescribed, that the mixture may be thinner; and, after the addition of the cold water, the degree of temperature should not at the highest exceed 8° or 9° of Reaumur. It is of very great advantage, in those situations where it can be done, to surround the distillery with water, to the height of a foot, in stormy and in very hot weather. This water absorbs the heat, which would otherwise strike to the matter, hasten the fermentation too much, turn the matter sour, and occasion a considerable loss of spirit.

Description of a Pyrometer of Platina; invented by M. GUYTON.

From the ANNALES DE CHIMIE.

AT the meeting of the National Institute, on 26 Floreal (May 16), M. Guyton exhibited an instrument for measuring the highest degree of heat produced in furnaces.

It consists of a rod or bar of platina, placed edgewise in a groove, made in a bed of refractory clay. One end of this bar rests upon the brick-work that surrounds the groove; the other end bears upon a lever with two arms, the largest of which forms an index or needle upon an arch of a graduated circle; so that the movement of this index shews the encrease in length of the bar of metal by the heat.

The bed of clay having been burned in the most intense degree of heat, no apprehension need be entertained of its shrinking; and the dilatation it might experience during the time of incandescence, would affect only the very small distance of the needle's centre of motion from the point of contact with the bar, that is, so as to diminish the effect rather than augment it. The whole of this instrument being of platina, it is liable neither to fusion nor oxydation.

As to its dimensions, the author thinks they ought to be reduced as much as possible, only leaving them of the magnitude necessary for distinctly marking the variations, in order to render its use convenient and certain; *convenient*, for the facility of placing it beneath a muffle, or under a crucible reversed; *certain*, by reason of the dimunition of accidents arising from inequality of heat, which it is impossible to avoid to a certain extent, even amidst a large mass of fire.

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The variations will be sufficiently perceptible if the operator is able not only to calculate but to judge exactly of the prolongation of the bar, $\frac{1}{200}$ of a millimetre (about $\frac{1}{451}$ of a line), and this the author effects by the proportions he has adopted.

The bar is 45 millimetres in length, 5 broad, and 2 thick. The arm of the lever, which rests upon the extremity of this bar, is 2,5 millimetres in length, and the other, which acts as a needle upon the arch of the graduated circle, is 50 millimetres, or twenty times as long as the former. Thus the distance, which the shorter arm is displaced by the dilatation of the bar, will be multiplied in the proportion of one to twenty.

As the larger arm has a nonius, which shews on the same graduated circle the tenth parts of a degree, we thus have distinctly $\frac{1}{200}$ of one of these degrees.

Lastly, as the decimal division of an arch of a circle, whose radius is 50 millimetres, gives only 7,8538 decimillimetres for one of these degrees, it is evident that we may measure a prolongation of ,078538 decimillimetres or $\frac{1}{5730}$ of the length of the bar.

As it might happen that in drawing the instrument from the furnace, the motion might change the position which the dilatation had given to the needle, a spring of platina has been contrived at its extremity to keep it in its situation.

The author has begun a series of experiments to prove the accuracy of this pyrometer, to compare it with Wedgwood's, and thus determine what degree of reliance can be placed on those instruments, the manner of using them, and the cases in which they may be advantageously employed in scientific researches and in the arts.

Manner of making Vinegar with the Refuse of Beehives after the Honey is extracted.

By M. Lombard.

From the Bibliotheque Physico-Economique.

WHEN the honey is extracted from the combs by means of pressure, take the whole mass, break and separate it, and into each tub or vessel put one part of combs and two of water; place them in the sun, if his rays possess sufficient power, or in a warm place, and cover them with cloths. Fermentation takes place in a few days, and continues eight to twelve days, according to the higher or lower temperature of the situation in which the operation is performed. During the fermentation, stir the matter from time to time, and press it down with the hands, that it may be perfectly soaked. When the fermentation is over, put the matter to drain upon sieves or strainers. At the bottom of the vessels will be found a yellow liquor, which must be thrown away because it would soon contract a disagreeable smell, which it would communicate to the vinegar. Then wash the tubs, put into them the water separated from the other matter; it immediately begins to turn sour; when the tubs must be again covered with cloths, and kept moderately warm. A pellicle or skin is formed on their surface, beneath which the vinegar acquires strength; in a month's time it begins to be sharp; it must be left standing a little longer, and then put into a cask, of which the bung-hole is left open, and it may then be used like any other vinegar.

Account of Experiments shewing that violent Conflagrations may be extinguished by very small Quantities of Water by Means of a portable Hand-Engine.

By M. Van Marum.

From the Annales de Chimie.

A SWEDE, named Van Aken, nine years ago, publicly shewed at Stockholm, Copenhagen, and Berlin, that he could very expeditiously extinguish fires by a small quantity of a liquor, denominated anti-incendiary, and which he for some time kept secret. Having seen in the journals that M. Van Aken had repeated his experiments with great success at Berlin, in the presence of some of the members of the Academy of Sciences, I wrote to the celebrated M. Klaproth, requesting him to communicate to me the composition of M. Van Aken's anti-incendiary liquor if he was acquainted with it, with the intention of ascertaining the merit of the invention by an experiment on a large scale. For this purpose, as soon as M. Klaproth had communicated to me the method of preparing it, I caused a quantity to be made under my own inspection. It consists of a solution of 40 lbs. of sulphate of iron and 30 lbs. of sulphate of alumine, mixed with 20 lbs. of red oxyd of iron (colcothar) and 200 lbs. of clay. I then began to make comparative experiments by setting fire to two masses of combustibles, equal in every respect, and by extinguishing one of them with Van Aken's liquid and the other with common water. I was surprised to see, in several trials, that by using the two liquids in the same manner, the fire was always more expeditiously extinguished by water than by the anti-incendiary liquor; but I observed, at the same time, that

that a very small quantity of water, when properly directed, extinguished an extremely violent conflagration. My first experiments on this subject led me to make others on a larger scale; I shall take notice only of the latter.

I took two barrels which had contained pitch, and the inside of which was still covered with that inflammable substance. I took out the top and bottom of each, and, to give increased power to the flames, I altered them to a conical figure, twenty inches in diameter at the upper end, and sixteen inches at the other. This I placed on an iron frame, about three inches from the ground, that a free current of air, rising through the barrel, might render the flame as fierce as possible. I put a fresh covering of pitch over the inside of each barrel, and by means of shavings set fire to them one after the other. I began to extinguish the fire when most violent. For this purpose I employed an iron ladle, containing two ounces of water, and provided with a very long handle, as the heat of the fire kept me at the distance of four or five feet. I carefully poured the water out of the ladle in very small streams over the inside of the barrel, applying it to the edge, and moving it along the edge, according as the flames ceased. In this manner the first ladlefull put out nearly half of the fire; and what remained was extinguished by the second, applied in the same way.

The uncommon success of this experiment induced me to repeat it in the presence of several persons; and, by practice in the economical employment of water, I have more than once been able to extinguish a pitched barrel in a state of the most complete conflagration by a single ladlefull, consisting of two ounces of water.

It must at first appear surprising, that so small a quantity of water can extinguish such a violent fire. But the

the reason will easily be conceived upon reflecting that the flame of any burning substance must cease, according to well-known principles and experiments, as soon as any cause prevents the atmospheric air from touching its surface: thus, when a small quantity of water is thrown upon a body in a state of violent conflagration, this water is at first partly reduced to vapour, which, rising from the surface of the burning substance, repels the atmospheric air, and consequently represses the flame, which, for the same reason, cannot again appear whilst the production of the vapour continues.

From these experiments it appears that the art of extinguishing a violent conflagration with very little water consists in throwing it where the fire is most powerful, so that the production of vapour from the water, by which the flames are smothered, may be as abundant as possible; and in proceeding to throw the water on the nearest inflamed part, as soon as the fire ceases in that where you began, till you have gone over all the burning parts as expeditiously as possible. In thus regularly following the flames with the water, they may be every where extinguished before the part where you began has entirely lost, by evaporation, the water with which it was wetted, which is frequently necessary, to prevent the parts from taking fire again: after the flames of a burning body are extinguished, it cannot again take fire, for the above-mentioned reason, till all the water thrown upon it be evaporated.

Being convinced by these experiments, that very little water may suffice for extinguishing ordinary conflagrations, particularly at their commencement, I have endeavoured to convince many of my fellow citizens of it by repeating the experiments just described; and I have advised the procuring of small portable engines to

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be used in cases of necessity. Many followed my advice immediately, and after their good effects had been seen, in some cases their number increased more and more in many of the towns of Holland, especially after the experiment which I made here in May, 1797, to shew upon a larger scale the advantages that may be derived from a judicious application of water to extinguish even the most furious conflagrations by means of portable engines, with a very small quantity of water. The experiment was the following:

I constructed a shed of dry wood, forming a room, twenty-four feet long, twenty wide, and fourteen high, having two doors on one side, and two windows on the other. This shed was provided with the wood-work of a roof, but was not covered, and stood about six inches from the ground, that there might be a thorough current of air to increase the fierceness of the flames when the building should be set on fire. The inside of it was completely covered with pitch, and lined with straw, which was likewise pitched. To this straw lining I fastened wood-shavings, and cotton dipped in oil of turpentine, to set fire to the whole inside of the shed at once. Soon after the fire was applied, the flames being increased by the wind, were every where so violent that all the spectators thought they could not possibly be extinguished. I however succeeded in about four minutes, by the method already described, with five buckets of water, part of which was wasted through the fault of those who assisted me, as the following experiment proved.

I invited but very few to be present at this first experiment on the 8th of May, but on the 11th I repeated it in the presence of a very numerous company, after repairing and restoring the shed to its original state. The fire was not less violent than in the preceding experi-

ment.

ment. I then directed the water myself, without any assistance, and effectually extinguished the fire in three minutes, having used only three buckets of water, each containing about four gallons and a half.

Being at Gotha, in July, 1801, the Duke and Dutchess of Gotha pressed me, at their expence, to repeat the experiment, of which they had seen the details in the German journals, that it might be made more generally known in that part of Germany, where, as in other countries, great injury is sometimes sustained from conflagrations, because the people know not how to employ judiciously the small quantity of water they have at hand. The obliging manner in which their highnesses requested me to repeat the experiment, and my wish to make it of more general utility induced me to undertake it. The celebrated astronomer Von Zach was likewise present, and drew up the account inserted in a German periodical publication, intituled, "Reichs Anzeiger," of 6th August, 1798.

M. Lalande arrived at Gotha four days after the experiment, and was informed of its result. He mentioned it, as he lately informed me, soon after his return to Paris, to the National Institute, but he at the same time told me, that doubts were entertained of the truth of his narrative. To remove all doubts on this head, I shall annex the following account of the experiment, drawn up by the celebrated astronomer of Gotha, and inserted by him in the above-mentioned periodical publication.

"Doctor Van Marum having made some stay at Gotha in the course of a literary tour in Germany, in 1798, the Duke of Gotha, known as an amateur of the mathematical and physical sciences, expressed a wish that he would exhibit, on a large scale, an experiment of his method of extinguishing fire, the effect of which M. Van

Marum had shewn by extinguishing, by means of a ladle-full of water, a pitched barrel, which he had set on fire. A shed of old, and perfectly dry, wood was in consequence erected, under the direction of M. Van Marum, in front of the dutchess's garden. Its dimensions were in every respect equal to that which served for the same experiment at Harlem, being twenty-four feet long, twenty wide, and fourteen in height. There were two doors on the north-east side, and two large apertures, in the form of windows, on the north-west side. The top was quite open, to give the flames a free passage.

"The inside of this shed was covered with pitch, and afterwards with straw mats, plentifully besmeared with melted pitch. To the bottom of these straw mats were fastened cotton wicks, dipped in spirits of turpentine, that the place might take fire in every part at once. In consequence, the fire being considerably increased by the wind, was at first so powerful, and the flames enveloped in thick clouds of smoke, rose with such violence, to the height of several feet above the opening of the roof, that the nearest spectators were obliged to retire precipitately, and many of them declared that it would be impossible to extinguish the conflagration, and that the shed would be entirely reduced to ashes. When the straw mats were completely consumed, the wood of the shed was soon in flames in every part. The circumstances under which this experiment was made were highly unfavourable; for the wind drove the flame exactly out at the doors on the north-east side, at which the water for extinguishing it was to be introduced. But notwithstanding this, M. Van Marum placed a small portable engine before the door, nearest the south-east side, without regard to the fears and opposition of his assistants, and ordered it to be worked there, stationing himself as

near

near as the heat of the fire would permit him; he first directed the water to the south-east side, as near the door as possible, and as soon as the flame was extinguished in one part he guided the water to another. He then directed it along the north-east side, so that in a few minutes the flames were completely extinguished on those two sides. The engine was then placed before one of the apertures made in the form of windows, on the north-west side. He in a very short time extinguished the south-east side, and then coming to the middle of the shed, which was still on fire in several places in the crevices of the planks and the holes made by the nails, he completely extinguished the fire, which from time to time broke out again in small flames, and this terrible conflagration was entirely got under. According to the calculation of several of the spectators, the fire was extinguished in three minutes, at most, after the engine began to work. It is true the flames broke out again in several places, but they were of so little consequence that they were extinguished by means of wet rags fastened to a stick. Before the engine began to work, the reservoir was filled at two different times with two buckets of water. But in the removal of the engine to the first aperture or window of the shed, and afterwards to the middle of it, a considerable quantity of water, that may be estimated at nearly a pailfull, was spilt; so that it may with truth be asserted, that this violent conflagration was extinguished by three buckets of water, exclusive of what was afterwards used to extinguish those parts of the shed that remained red. When the fire was out, every one could see that it was not only the matted straw which had been burned, but that the wood, of which the building was constructed, had been so completely on fire that the space of an inch could not be found that had not

been burned to a greater or less depth. The north-east side in particular, against which the wind had driven the flames with the greatest violence, was entirely charred. The experiment made at Gotha differs materially from that at Harlem in the following particular, that the flames and thick smoke that issued from the doors, rendered the approach to the shed with the engine extremely difficult at the former place, so that it was only by persuasion, and the courageous example he himself set, by placing himself always in front with the engine-pipe, that M. Van Marum could induce his assistants to approach the danger they so much dreaded."

From what has been already stated, it results, that in the application of this method of extinguishing fire, the whole art consists in attending to what follows: that to stop the most violent flame it is necessary only to wet the surface of the burning substance where the flame appears, and for this purpose only a small quantity of water is required, if it be applied with judgment to the burning part. Thus the point to be attended to in extinguishing a fire is to direct the water so that the whole surface of the burning part may be wetted and extinguished, and that in such a manner that no extinguished spot may be left between two others that are on fire: for if attention be not paid to this particular, the heat of the flame burning here and there, rapidly changes into vapour the water with which the extinguished wood has been wetted, and it again takes fire. Therefore, to extinguish fire of every kind, and in whatever manner it may have happened, nothing more is necessary than to apply to the burning part a sufficient quantity of water to wet its surface.*

On

On some Experiments made with a Magnetic Needle, in order to distinguish immediately a Bar of Iron from a Bar of Steel. By P. Torelli di Narci.

From the Journal des Mines.

I MADE two small square magnetic bars, four inches long, and two, or two and a half, lines on each side; and in order to try their attractive and repulsive force, I held them to a magnetic needle, about three inches in length; I judged, by the distance at which they acted, of their greater or less degree of magnetic power.

I had at hand some bars of steel, of different forms, sizes, and lengths, which had never been polished, tempered, or rubbed with the loadstone. I held one of these bars to the magnetic needle, to see at what distance it would act, but I found it inconsiderable in comparison to the magnetic bars which I had made.

At this moment the idea occurred to me to repeat the experiment of the polarity of a common bar of iron, to see at what distance that would act.

This experiment consisted, as every one knows, in holding alternately to the two extremities of a magnetic needle, fixed on its pivot, the ends of a bar of iron, eighteen or twenty-four inches in length, more or less, which is held in a vertical position, and which, by this alone, is instantly rendered magnetic, and thus acquires polarity (if that expression may be used to signify that it acquires two poles); so that if the lower extremity of the bar of iron be held to the end of the needle marked N, which turns towards the north, it is repelled, which shews that this lower extremity is the north pole of the bar when placed vertically. If the iron bar be lowered, still keeping it in a vertical position, and if without derang-

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ing the needle, which must be placed on the edge of a table, the other extremity or upper end of the bar of iron be held towards it, attraction then takes place, and this extremity is found to be the south pole of the bar.

If the bar be reversed, the poles instantly change by this alteration; which may be ascertained by presenting it in this new position to the magnetic needle.

This experiment, which is well known, proves that by the vertical situation a bar of iron becomes an artificial magnet.

I resolved to repeat it with the bars of unwrought steel which I had in my possession, but I obtained results so different and so various that I thought it would be interesting to begin these experiments again in some order, for the purpose of comparing them with each other. One of their results is, that they have furnished me with a very simple method of immediately distinguishing a bar of iron from a bar of steel. A bar of iron acquires polarity by its vertical position alone, but with steel the case is otherwise, as the following experiments evince.

Care must be taken that the bar of steel employed shew no sign of magnetism, which may easily be discovered by plunging it into iron filings, or by alternately presenting each extremity of the bar of steel to the two ends of the magnetic needle.

It frequently happens that steel acquires the magnetic property by a simple shock, or a slight friction; but the experiments which I am about to describe will serve to shew whether the bar of steel that is intended to be tried has obtained the smallest degree of magnetic power or not.

I took a square bar of steel, about twelve or fourteen inches long, by two, or two and a half lines in thickness,

which

which gave no indication of magnetism; I held it vertically, and presented the lower end to the north pole of the needle; attraction took place, which proves that this lower extremity of the bar of steel had not become the north pole by the vertical situation. I reversed the bar of steel, and obtained the same result, that is, there was an attraction; I lowered it vertically, for the purpose of bringing its upper extremity near the north pole of the needle, fixed on its pivot, and placed on the edge of the table; I still found that there was attraction. I then presented the same extremity of the steel bar, still holding it vertically to the south pole of the needle; it was again attracted; which proves that this bar had not acquired any polarity, and likewise that it afforded no sign of magnetism, nor consequently of polarity; for if a bar of steel obtain, in any manner whatever the smallest degree of magnetic power, the poles immediately shew themselves.

To prove that it is the vertical situation alone which instantly gives poles to a bar of iron, and makes it a kind of artificial magnet, I shall mention an experiment that I have made, and which I have no where seen described. The idea of making it arose from a desire to discover whether a bar of steel, which had afforded signs of attraction and repulsion, when held vertically, actually had poles.

After having proved the polarity of a bar of iron held vertically, and which I had reversed several times, to change its poles, I wished to ascertain whether it retained any sign of magnetism; for this purpose I held my bar of iron horizontally in the same manner, and at the same height, as my magnetic needle; I kept the bar nearly east and west, that is, perpendicular to the north and south direction of the needle; I advanced it by degrees

till

till I was near enough to act upon it, and attraction took place. I varied the experiment by reversing my bar, and presenting it alternately to the two extremities of the magnetic needle; it still produced attraction, which is an evident proof that this bar possessed no magnetic virtue, and that its magnetism and polarity were owing to its vertical position alone.

Another experiment, which follows, confirms this assertion. I presented the bar of iron, holding it horizontally to the north extremity of the magnetic needle; I slowly brought it nearer, till I perceived a commencement of attraction, when, without deranging the extremity of my bar of iron, next to the needle, I raised up the other end, which was farthest from it, so as to make it describe the arch of a circle, whose centre was at the extremity of the bar next to the needle. I then observed, that in proportion as I raised the extremity of my bar of iron, and it traversed the arch of 90 degrees, to pass from the horizontal to the vertical line, the attraction which existed between the extremity of the bar and the north pole of the needle was converted by degrees into repulsion; and it was sufficient for me to describe an arch of 20 degrees with my bar before I began to perceive the repulsion. I cannot positively say whethe the maximum of repulsion is obtained by the vertical situation; it appeared to me to increase till about 70 or 80 degrees, where it stopped. These are delicate experiments, and, to appreciate their effects, it requires instruments appropriated to the purpose, and skilful persons to manage them.

By reversing this experiment, that is, placing the whole apparatus in the same manner, but lowering the extremity of the bar of iron farthest from the magnetic needle, instead of raising it, and describing with it the

fourth

fourth part of a circle, below, quite contrary effects are produced, that is the attraction is more and more augmented.

If the experiment be repeated with the south end of the needle, you obtain the same results reversed.

The following are the experiments I have made with bars of steel, which afforded some signs of magnetism.

The first bar of steel which I employed for the purpose of repeating the experiments, which prove that iron instantly acquires polarity by its vertical position alone, and to ascertain whether the same were the case with steel, convinced me that it did not possess the same property.

I was desirous of repeating this experiment with other bars of steel, of different forms, sizes, and lengths. I took some round pieces of steel, three, four, and up to six lines in diameter, and from fifteen to eighteen inches long. I likewise took bars, twelve or fifteen inches in length, and three or four lines on each side; in a word, any that I happened to have in my laboratory, form and magnitude being objects of perfect indifference.

I found some of these bars, which, upon the first experiment, that is, upon being held vertically, and bringing the lower end near the north pole of the needle, shewed an evident repulsion. This at first disconcerted me. I turned the bar the contrary way, and attraction took place; which convinced me that the bar of steel had begun to acquire a magnetic power, which had given it poles. I continued my experiments, presenting (as in those made with the bar of iron, and described above) the extremities of the bar of steel, held in a horizontal position, to the north end of the needle. I then, by alternately changing the end, obtained attraction or repulsion, according as the same or the opposite poles of the

bar of steel and the magnetic needle were approached to each other.

Among the bars of steel, of the forms, sizes, and lengths above mentioned, which I tried, I found only three which gave no indication of the commencement of magnetism, and with which the experiments just related perfectly succeeded. With regard to those which indicated the commencement of magnetism, and consequently of polarity, from the experiments in which they were employed, it may be concluded that they were of steel, since they had acquired and preserved a sufficient degree of magnetism to discover their poles; a property not possessed by iron, which neither preserves its polarity nor magnetism in any other than a vertical position, and in which that property is so unsteady, that if you reverse a bar of iron it is sufficient to change the poles, and, by placing it horizontally, it loses all its polarity and magnetic power.

From the experiments just described, I think it may be concluded, that a bar of iron may easily be distinguished from one of steel by presenting it to the magnetic needle.

If the bar which is tried instantly acquires polarity by being placed vertically, which is seen by the attractions and repulsions observed in the course of the experiment, and if it lose that polarity when held horizontally, which is easily discovered, because in this latter position whatever end is presented, and whichever pole of the magnetic needle is approached, the phenomenon of attraction will always be observed; if, finally, upon turning it, the pole be changed, and that as often as the bar is reversed, it may confidently be pronounced a bar of iron.

If,

If, on the contrary, the bar submitted to the same experiments shews no sign of polarity, and attract indifferently the two extremities of the needle, in whatever manner and situation it be presented, then it may be concluded that the bar which is tried is of steel.

If this same bar shew signs of polarity, and in whatever situation it be presented, the phenomena of the attraction of the opposite poles of the needle and the bar, and the repulsion of the same poles, invariably and uniformly take place, it may thence likewise be concluded that the bar is of steel, for steel alone possesses the property of acquiring and preserving, for a very long period, even when not tempered, the smallest degrees of magnetism.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

New Metallic Alloy called Palladium.

IN a paper lately read before the Royal Society, by Mr. Chenevix, concerning the nature of a metallic substance lately sold in London, as a new metal, under the title of Palladium, Mr. Chenevix describes the properties of an alloy of platina and mercury, which was described by the person who first made it as a new noble metal, and exposed by him for sale at Mr. Forster's, in Gerrard street.

Palladium, or the new alloy, resisted all the attempts that were made to decompose it, and Mr. Chenevix was led to the discovery of its nature only by synthetical experiments. It is produced by different methods, but all

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of them are in some measure capricious. One of the most simple is by the action of a solution of green sulphate of iron upon a mixture of a solution of mercury and a solution of platina. In the process that succeeded best, heat was applied.

The palladium sold by Mr. Forster, which is perhaps the most perfect combination of mercury and platina, is of a specific gravity about 11; but different solid alloys, containing mercury and platina, of different specific gravities, between 11 and 15, were obtained by Mr. Chenevix.

The palladium and the alloys that Mr. Chenevix obtained most resembling it were of a dull grey colour, approaching to that of platina; when palladium was acted upon by fire, its tint changed like that of steel. At an intense white heat it entered into fusion, and burned when in contact with oxygene. It combined with sulphur at a moderate heat.

It was acted upon by all the mineral acids; a solution of it may be made in the nitric acid, which is of a bright red colour.

It was precipitated from its solutions in an oxydated state by the alkalies and earths, and generally of an orange tint.

The solutions of the alloy gave a deep orange or brown precipitate to muriate of tin, an olive coloured one to prussiate of potash, and to sulphurated hydrogene gas a dark brown one.

In no way could the mercury and platina, after they had once entered into union, be separated from each other; but, from his most accurate experiments of composition, Mr. Chenevix concludes, that the two metals are to each other nearly as one to two.

After

After having completed the account of his researches upon palladium, Mr. Chenevix gives the history of some experiments on the affinity between the metals, which he thinks prove,

1. That gold has an attraction for mercury, for antimony, and for arsenic.

2. That platina has an affinity for silver, for mercury, and for antimony.

3. That silver has an affinity for mercury. And,

4. That mercury has an affinity for copper, for lead, and for arsenic.

In the course of some observations that he made upon the salts of platina, he mentions that the muriate of tin is the most delicate test for this metallic body. It acts in the smallest quantity upon its muriatic solution, and renders it of a bright red colour.

Mr. Chenevix anticipates the objections that might be brought forward against his opinions, in consequence of the small specific gravity of palladium, which is much less than that of either of the metals supposed to compose it, and on this subject he mentions some instances in which very great changes of specific gravity arise from combination; and remarks, that we have no right to disbelieve a fact because no parallel instance can be adduced, as such a conduct would be raising an insurmountable barrier against the progress of science; it would be setting up our own feelings in the place of nature.

Gunpowder.

In another paper, read at the Royal Society, from Mr. Roebuck, of Madras, communicated by Mr. Watt, Mr. Roebuck states, that nitre loses something by being washed, which renders it less proper for forming gunpowder.

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He likewise states, that gunpowder much stronger than that usually made may be formed by adding nitric acid to the nitre employed. The proportion is one ounce of strong nitric acid to ten pounds of nitre. A solution is made, and the nitre is recrystallized. In Madras two kinds of charcoal are made use of for gunpowder, the one from the dolichos saja, the other from the euphorbia tirucalli.

The proportions are,

Nitre	45
Charcoal of the first kind	8
Sulphur	7

Or,

Nitre	45
Charcoal of the second kind	10
Sulphur	5

The two kinds of gunpowder are, according to Mr. Roebuck, of the same strength, and superior to the powder in use in the king's navy.

Ship's Log.

M. Seguin has invented a new log, by means of which he hopes to obtain the distance a ship goes with greater accuracy than by the common log. The latter, it is well known, consists of a triangular frame, to which is fastened a line with knots, a certain number of fathoms distant from each other. The pilot throws this frame into the sea, lets the line run out for half a minute, and then counts the knots. If three knots run out in that time, the vessel proceeds at the rate of a league an hour, and so in proportion.

proportion. The new log is furnished with a wheel, which is set in motion by the water. An index, which goes through the divisions, points out the distance which the ship has gone *.

The public is already indebted to M. Seguin for another instrument, invented in 1790, and approved by the commissioners of longitude, of Amsterdam. The latter is a compass with four legs, which serves to reduce, to the true distance, the apparent distance of the centre of the moon from the centre of the sun or a star, and consequently to simplify the calculations for obtaining the longitude.

New Method of Tiling Buildings.

M. Cathala, a French architect, has invented a new method of employing tiles for the roofs of houses; by which one half of the quantity usually required for that purpose is sufficient. The tiles are to be made of a square instead of an oblong form. The hook by which they are fastened is at one of the angles, so that when fastened to the laths, they hang down diagonally, and every tile is covered one-fifth part, on two sides, by the superior row †.

* Several patents have been published in this work for improvements in ships' logs, and seemingly upon the same principle as that described by M. Seguin.

† A gentleman in this country (Mr. Chiffney) some little time since obtained a patent for laying slates in a similar manner.

List

List of Patents for Inventions, &c.

(Continued from Page 400.)

CHESTER GOULD, of Red Lion-street, Clerkenwell, Middlesex, Gentleman; for an hydrometer on a new principle, for the purpose of ascertaining the strength of spirits, and determining the specific gravity of fluids. Dated September 3, 1803.

JOHN ISAAC HAWKINS, late of Bordenton, in the United States of America, now residing in King-street, Clerkenwell *, Middlesex, Merchant; for machinery and methods for writing, painting, drawing, ruling lines, and other things; and for applying part of the aforesaid machinery to other purposes. Dated September 24, 1803.

ROBERT RANSOME, of Ipswich, Suffolk, Iron-founder, being one of the people called Quakers; for a method of making and tempering cast-iron plough-shares, and other articles of cast-iron for agricultural uses. Dated September 24, 1803.

* We are requested to state that Mr. Hawkins has since removed to No. 21, Pall Mall, where he exhibits the above inventions.

END OF THE THIRD VOLUME, SECOND SERIES.

INDEX

TO THE

THIRD VOLUME, SECOND SERIES.

L *Lamp*,

Phosphorus,

Smith,

W *Waggon,*

Printed by NICHOLS and SON, Red-Lion-Passage, Fleet-street.